RELIANCE ELECTRIC

SP600 AC Drive
User Manual
Version 3.0

6SB401 Series

20 HP to 200 HP @ 460 VAC

20 HP to 150 HP @ 575 VAC

Instruction Manual D2-3501-5

Rockwell Automation

The information in this manual is subject to change without notice.

Throughout this manual, the following notes are used to alert you to safety considerations:

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

The thick black bar shown on the outside margin of this page will be used throughout this instruction manual to signify new or revised text or figures.

ATTENTION: Only qualified personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this document in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been removed. After disconnecting input power, wait five minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The drive can operate at and maintain zero speed. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audible or visual alarms, or other devices to indicate that the drive is operating, or may operate, at or near zero speed. Failure to observe this precaution could result in severe bodily injury or loss or life.

ATTENTION: The drive contains ESD- (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing, or repairing the drive. Erratic machine operation and damage to, or destruction of, equipment can result if this procedure is not followed. Failure to observe this precaution can result in bodily injury.

ATTENTION: The user must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuitry must disable the system in case of improper operation. Uncontrolled machine operation may result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

ATTENTION: The user is responsible for conforming with all applicable local and national codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

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CHAPTER 1
Introduction

This manual is intended for qualified electrical personnel familiar with installing, programming, and maintaining AC drives.

This manual contains information on:

- Installing and wiring the SP600 drive
- Programming the drive
- Troubleshooting the drive

The latest version of this manual is available from or http://www.reliance.com/docs_onl/online_stdrv.htm.

1.1 Manual Conventions

Parameter names: In most instances, parameter names are shown as the parameter name followed by the parameter number. For example: PI Control (125).

1.2 Getting Assistance from Reliance Electric

If you have any questions or problems with the products described in this instruction manual, contact your local Reliance Electric sales office.

For technical assistance, call 1-864-284-5444. Before calling, please review the troubleshooting section of this manual and check the standard drives website for additional information. When you call this number, you will be asked for the drive model number and this instruction manual number. Also, please have your product version number ready (refer to chapter 12).

CHAPTER 2

About the Drive

The SP600 AC drive is a pulse-width-modulated (PWM) drive that provides general purpose (sensorless vector or volts/hertz) regulation for a broad range of applications requiring adjustable speed control of motors.

This chapter provides information about the SP600 AC drive, including:

- Information on identifying the drive
- Descriptions of NEMA ratings
- Descriptions of features
- A description of drive connections and communication options

2.1 Identifying the Drive by Model Number

Each SP600 AC drive can be identified by its model number, as shown in figure 2.1. The model number is on the shipping label and the drive nameplate. The model number includes the drive and any factory-installed options. Model numbers and drive power ratings are provided in table 2.1.

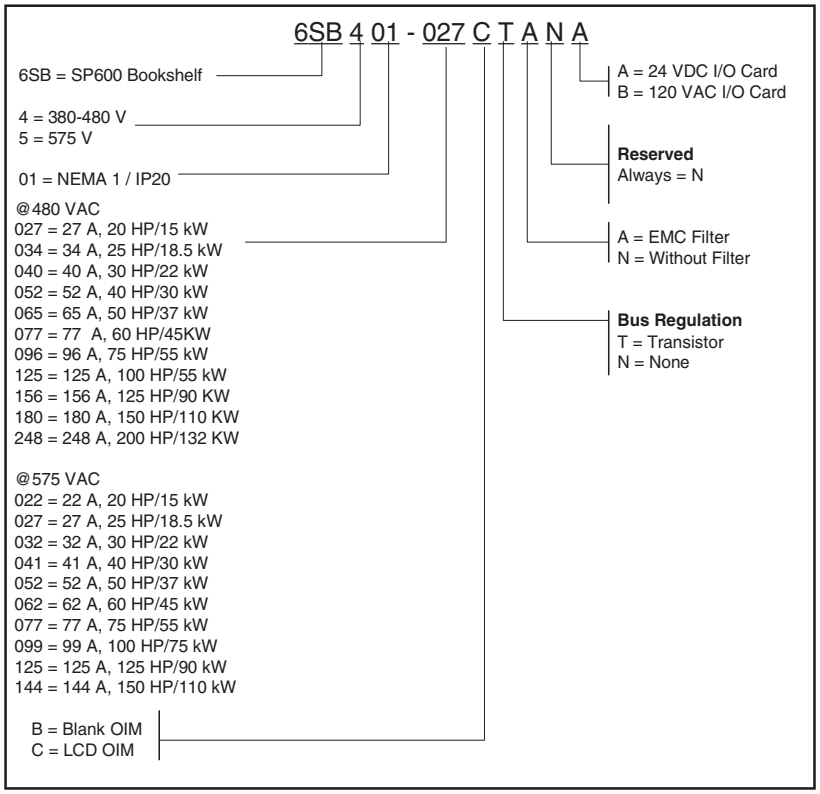


Figure 2.1 – Identifying the Drive by Model Number

2.2 Power and NEMA Enclosure Ratings

Each of the SP600 AC drives in the 6SB401 Series has a NEMA 1 rating:

- NEMA 1: Vented. Intended for general-purpose indoor applications.

Tables 2.1 and 2.2 provide a listing of the drives and their ratings.

Table 2.1 – Power Ratings

Model Number	Frame	Output Amps						Nominal Power Ratings				Input KVA @480 VAC	Input Amps @ 480 VAC	Watts Loss @ 4 kHz @ 480 VAC
		480 VAC			400 VAC			110% OL Duty		150% OL Duty				
		Cont	1 Min	3 Sec	Cont	1 Min	3 Sec	kW	HP	kW	HP			
-027xxxxx	2	27	33	44	30	33	45	15	20	11	15	20.6	24.8	394
-034xxxxx	2	34	40.5	54	37	45	60	18.5	25	15	20	25.9	31.2	441
-040xxxxx	3	40	51	68	43	56	74	22	30	18.5	25	30.5	36.7	459
-052xxxxx	3	52	60	80	56	64	86	30	40	22	30	39.7	47.7	610
-065xxxxx	3	65	78	104	72	84	112	37	50	30	40	49.6	59.6	717
-077xxxxx	4	77	97.5	130	85	108	144	45	60	37	50	60.1	72.3	974
-096xxxxx	5	96	106	144	105	116	158	55	75	-	-	74.9	90.1	1146
		77	116	154	85	128	170	-	-	45	60	60.1	72.3	974
-125xxxxx	5	125	138	163	125	138	163	55	100	-	-	97.6	117	1475
		96	144	168	96	144	168	-	-	45	75	74.9	90.1	1146
-156xxxxx	6	156	172	234	170	187	255	93	125	-	1	122	147	1827
		125	188	250	140	210	280	-	-	75	100	109	131	1475
-180xxxxx	6	180	198	270	205	220	289	110	150	-	-	141	169	2297
		156	234	312	170	255	313	-	-	100	125	122	147	1827
-248xxxxx	6	248	273	372	260	286	390	132	200	-	-	194	233	3270[1]
		180	270	360	205	305	410	-	-	110	150	141	169	2297[1]

[1] 248 amp drives rated at 2 kHz

Refer to Appendix A for drive technical specifications.

Table 2.2 – Power Ratings

Model Number	Frame	Output Amps 575 VAC Cont	1 Min	3 Sec	Nominal Power Ratings 110% OL Duty kW	HP	150% OL Duty kW	HP	Input KVA @ 575 VAC	Input Amps @ 575 VAC	Watts Loss @ 4 kHz @ 575 VAC
-022xxxxx	2	22	25.5	34	15	20	11	15	20.1	20.2	334
-027xxxxx	2	27	33	44	18.5	25	15	20	24.7	24.8	376
-032xxxxx	3	32	40.5	54	22	30	18.5	25	29.3	29.4	408
-041xxxxx	3	41	48	64	30	40	22	30	37.4	37.6	552
-052xxxxx	3	52	61.5	82	37	50	30	40	47.5	47.7	689
-062xxxxx	4	62	78	104	45	60	37	50	58	58.2	797
-077xxxxx	5	77	85	116	55	75	-	-	72	72.3	1653
		63	94	126	-	-	45	60	58	58.2	910
-099xxxxx	5	99	109	126	75	100	-	-	92.5	92.9	2243
		77	116	138	-	-	55	75	72	72.3	1752
-125xxxxx	6	125	138	188	90	125	-	-	116.5	117	2386
		99	149	198	-	-	75	100	92.6	93	2336
-144xxxxx	6	144	158	216	110	150	-	-	134.5	135	2836
		125	188	250	-	-	90	125	116.7	117	2498

2.3 Overview of SP600 Features

This section provides an overview of the features in the SP600 AC drive.

2.3.1 Analog Inputs

There are two general-purpose analog inputs that can be configured either as voltage (±10 VDC or current (4-20 mA) inputs. These inputs are configured via parameters to provide some flexibility.

The analog inputs provide input signals that can be used for the following purposes:

- Provide a value to Speed Ref A (Speed Ref A Sel (90))
- Provide a trim signal to Speed Ref A (Trim in Sel (117))

- Provide a reference when the terminal block has assumed manual control of the reference (TB Man Ref Sel (96))
- Provide the reference and feedback for the process PI loop (PI Ref Sel (126) and PI Feedback Sel (128))
- Provide an external value for the current limit and DC braking level (Current Limit Sel (147) and DC Bake Lvl Sel (157))
- Enter and exit sleep mode (178 to 183))

Refer to the parameter descriptions in chapter 11 for more information about configuring the analog inputs.

2.3.2 Analog Outputs

The drive has one analog output that can be used as a voltage (-10 to 10 V) or current (4-20 mA) signal to annunciate a wide variety of drive operating conditions and values. Select the source for the analog output by setting Analog Out1 Sel (342).

Refer to parameter 342 in chapter 11 for the analog output source options.

2.3.3 Digital Outputs

The SP600 drive provides two relay outputs for external annunciation of a variety of drive conditions. Each relay is a Form C (1 N.O. - 1 N.C. with shared common) device whose contacts and associated terminals are rated for a maximum of 250 VAC or 220 VDC.

See parameters 380 and 384 in chapter 11 for the drive conditions that can be annunciated.

2.3.4 Multiple Control Modes

The SP600 drive provides a number of user-selectable control modes to suit different applications:

- Sensorless Vector
- Sensorless Vector Economizer
- Custom Volts per Hertz
- Fan and Pump volts per Hertz

See the parameter description for Torque Perf Mode (53) in chapter 11 for details of operation of each control mode.

2.3.5 Multiple Stop Methods

There are several stop methods that can be selected using drive parameters 155 and 156:

- Coast to Stop
- Brake to Stop
- Ramp to Stop
- Ramp to Hold

Refer to the parameter descriptions in chapter 11 for more information about these stop mode selections.

Another stop method, dynamic braking, uses an optional internal or external DB braking resistor to dissipate stopping energy. See parameters 161 to 163 for more information about this feature.

2.3.6 Multiple Speed Control Methods

The purpose of speed regulation is to allow the drive to adjust to certain operating conditions, such as load change, and compensate for these changes in an attempt to maintain motor shaft speed within the specified regulation percentage.

The Speed Mode parameter (80) selects the speed regulation method for the drive, and can be set to one of 3 choices

- Open Loop - No speed control is offered
- Slip Comp - Slip Compensation is active
- Process PI - The PI loop sets the actual speed based on process variables.

Refer to parameter 80 in chapter 11 for more information.

2.3.7 Auto/Manual Reference Selection

You can override the selected “auto” reference by either toggling a function key on the OIM or asserting a digital input (Digital In”x” Sel (361 to 366)) that has been configured for Manual. This provides a source for local speed reference control even if a process input signal is the primary speed reference source.

Refer to the parameter descriptions in chapter 11 for more information.

2.3.8 Seven Preset Frequency Setpoints

There are seven preset frequency parameters (101 to 107) that are used to store a discrete frequency value. This value can be used for a speed reference or process PI reference. When used as a speed reference, they are selected via the digital inputs or the DPI (network) reference command. Refer to the parameter descriptions in chapter 11 for more information.

2.3.9 Motor-Operated Potentiometer (MOP) Function

The Motor-Operated Pot (MOP) function is one of the sources for the frequency reference (selected in parameter 90). The MOP function uses digital inputs to increment or decrement the speed reference at a programmed rate.

The MOP has these components:

- MOP Rate parameter (195)
- Save MOP Ref parameter (194)
- MOP Frequency parameter (11)
- MOP increment input (parameters 361 to 366)
- MOP decrement input (parameters 361 to 366)

2.3.10 Auto Restart (Reset/Run)

The Auto Restart feature, enabled in parameter 174 (Auto Rstrt Tries), provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows for automatic restart in applications where the drive is used in remote or "unattended" operation.

Important: Only certain faults are allowed to be auto reset. Faults that indicate possible drive malfunction are not resettable. Caution should be used when enabling this feature, since the drive will attempt to issue its own start command based on user-selected programming.

Refer to the descriptions of parameters 174 and 175 in chapter 11 for more information about using the Auto Restart feature.

2.3.11 Autotune

The Autotune feature, enabled in parameter 61 (Autotune), identifies the motor flux current and stator resistance for use in Sensorless Vector Control and Economizer modes (selected in parameter 53). The result of the flux current test procedure is stored in the Flux Current parameter (63), and the product of Flux Current Ref (63) and stator resistance is stored in IR Voltage Drop (62).

There are three options for autotuning:

- Static - the motor shaft will not rotate during this test.
- Dynamic - the motor shaft will rotate during this test.
- Calculate - tuning data is selected based on the motor nameplate data entered.

The static test determines only stator resistance, while the dynamic Autotune procedure determines both the stator resistance and motor flux current.

IR Voltage Drop (62) is used by the drive to provide additional voltage at all frequencies to offset the voltage drop developed across the stator resistance. An accurate calculation of the IR Voltage Drop will ensure higher starting torque and better performance at low speed operation.

If it is not possible or desirable to run the Autotune tests, there are two other methods for the drive to determine the IR Voltage Drop and Flux Current parameters. One method retrieves the default parameters stored in the drive EEPROM, and the other method calculates them from the user-entered motor nameplate data parameters.

If the stator resistance and flux current of the motor are known, you can calculate the voltage drop across the stator resistance and directly enter these values into the Flux Current and IR Voltage Drop parameters.

Refer to the description of the Autotune parameter (61) in chapter 11 for more information about using this feature.

2.3.12 Drive Protection Current Limit

There are six ways that the drive protects itself from overcurrent or overload situations:

- Instantaneous overcurrent trip
- Software Instantaneous trip

- Software current limit
- Heatsink temperature protection
- Overload protection IT (see Drive Overload Protection, section 2.3.13)
- Thermal manager

2.3.13 Drive Overload Protection

The drive thermal overload will protect the drive power stage while maintaining performance as long as the drive temperature and current ratings are not exceeded.

The drive will monitor the temperature of the power module based on a measured temperature and a thermal model of the IGBT. As the temperature rises, the drive may lower the PWM frequency to decrease the switching losses in the IGBT. If the temperature continues to rise, the drive may reduce current limit to try to decrease the load on the drive. If the drive temperature becomes critical, the drive will generate a fault.

If the drive is operated in a low ambient condition, the drive may exceed rated levels of current before the monitored temperature becomes critical. To guard against this situation, the drive thermal overload also includes an inverse time algorithm. When this scheme detects operation beyond rated levels, current limit may be reduced or a fault may be generated.

2.3.14 Motor Overload Protection

The motor thermal overload function (enabled in parameter 238) uses an inverse time (IT) algorithm to model the temperature of the motor. This curve is modeled after a Class 10 protection thermal overload relay that produces a theoretical trip at 600% motor current in ten (10) seconds and continuously operates at full motor current.

The following parameters are used to set the overload feature:

- Motor NP FLA (42)
- OL Factor (48)
- Motor OL Hertz (47)
- Fault Config 1 (238)

Refer to parameter 42 in chapter 11 for more information about this feature.

2.3.15 .Shear Pin Fault

This feature allows you to program the drive to fault if the drive output current exceeds the programmed current limit (see parameter 238). As a default, exceeding the set current limit is not a fault condition. However, if you want to stop the process in the event of excess current, the Shear Pin feature can be activated. By programming the drive current limit value and enabling the electronic shear pin, the drive will fault if excess current is demanded by the motor

2.3.16 .Drives Peripheral Interface (DPI)

SP600 drives support Drive Peripheral Interface (DPI) communication protocols for the primary interface and drive control. The DPI interface is an enhanced serial communications protocol that provides high functionality and high performance.

The serial DPI connection is used for devices such as Operator Interface Modules (OIMs), PC interface tool (VS Utilities), and network communication modules.

2.3.17 Network Data Transfer via Datalinks

A Datalink (see parameters 300 to 317) is one of the mechanisms used by SP600 drives to transfer data to and from a programmable controller via the optional network interface modules (e.g. DeviceNet or ControlNet). In the case of ControlNet, Datalinks allow a parameter value to be changed without using an Explicit Message or Block Transfer.

Each Datalink (e.g. A1, A2 for Datalink A) transfers two 16-bit values (A1, A2). If a 32-bit value needs to be transferred, each of the two 16-bit Datalinks must be set to the same parameter. One Datalink transfers the lower 16 bits; the other, the upper 16 bits.

For example, to set up the drive to receive accel and decel times from the connected PLC you would make the following parameter settings:

Data In A1 (300) = 140 (the parameter number of Accel Time 1)
Data In A2 (301) = 142 (the parameter number of Decel Time 1)

2.3.18 Programmable Parameter Access Levels and Protection

The SP600 drive allows you to limit the number of parameters that can be viewed on the LCD OIM using an Access Level password. By limiting the parameter view to the most commonly adjusted set, additional features that may make the drive seem more complicated are hidden.

If you are trying to gain access to a particular parameter and the OIM skips over it, you must change the parameter view from "Basic" to "Advanced." This can be accomplished by reprogramming Param Access Lvl (196) to "Advanced". See section 10.3.1 for instructions.

2.3.19 Process PI Loop

The internal process PI function (see parameters 124 to 138) provides closed-loop process control with proportional and integral control action. The PI function reads a process variable input to the drive and compares it to a desired setpoint stored in the drive. The algorithm will then adjust the output of the process PI regulator thereby changing drive output frequency to try to make the process variable equal the setpoint.

Refer to the descriptions of parameters 124 and 138 in chapter 11 for more information.

2.3.20 S Curve

The S Curve function of SP600 drives allows control of the "jerk" component of acceleration and deceleration through user adjustment of the S Curve parameter (146). Jerk is defined as the rate of change of acceleration and/or deceleration. By adjusting the percentage of S Curve applied to the normal accel/decel ramps, the ramp takes the shape of an "S" allowing a smoother transition that produces less mechanical stress and smoother control for light loads.

Refer to the description of parameter 146 in chapter 11 for more information.

2.3.21 Three Skip Bands (Avoidance Frequencies)

The skip band function (see parameters 84 to 87 in chapter 11) provides three skip bands (also called avoidance frequencies) that the drive will ramp through but will not continuously run within. You can set the skip frequency (center frequency) and bandwidth of each band.This function is used to avoid mechanical resonance operating setpoints.

2.3.22 Flying Start

The flying start feature (enabled in parameter 169) is used to start into a rotating motor as rapidly as possible and resume normal operation with a minimal impact on load or speed. This action will prevent an overcurrent trip and significantly reduce the time for the motor to reach its desired frequency. Since the motor is "picked up" smoothly at its rotating speed and ramped to the proper speed, little or no mechanical stress is present.

Refer to the description of parameter 169 in chapter 11 for more information.

2.3.23 Voltage Class

The voltage class (see parameter 202 in chapter 11) identifies the general input voltage to the drive. This general voltage includes a range of actual operating voltages. A 400 volt class drive will have an acceptable input voltage range of 380 to 480 VAC. A 575 volt class will have a range of 475 to 632 volts.

While the hardware remains the same within each class, other variables, such as factory defaults and power unit ratings, will change. In most cases, all drives within a voltage class can be reprogrammed to accommodate a motor within its voltage class. This can be done by resetting the Voltage Class parameter to a different setup within the voltage class.

As an example, consider a 480 volt drive. This drive comes with factory default values for 480 V, 60 Hz, with motor data defaulted for U.S. motors (HP rated, 1750 RPM, etc.) By setting the Voltage Class parameter to "low voltage" (this represents 400 V in this case) the defaults are changed to 400 V, 50 Hz settings with motor data for European motors (kW rated, 1500 RPM, etc.).

2.3.24 Motor Cable Lengths

The length of cable between the drive and motor may be limited for various application reasons. The primary areas of concern are:

- Reflected wave
- Cable charging

The reflected wave phenomenon, also known as transmission line effect, produces very high peak voltages on the motor due to voltage reflection. While Reliance Electric drives have patented software that limits the voltage peak to 2 times the DC bus voltage and reduce the number of occurrences, many motors have inadequate insulation systems to tolerate these peaks.

Caution should be taken to understand the effects and restrictions when applying the drive to extended motor lead length applications. Proper cable type, motor and drive selection is required to minimize the potential risks.

2.3.25 Economizer Mode

Economize mode consists of operating the drive in sensorless vector control mode with an energy saving function (E-SVC). When the drive is in this mode and operating at steady state output frequency, the output voltage is automatically adjusted as the load is increased or decreased. This is done so that minimum current is supplied to the motor thereby optimizing its efficiency. By adjusting the output voltage, the flux producing current is reduced, but only if the total drive output current does not exceed 75% of motor rated current. In this mode the flux current is not allowed to be less than 50% of the selected flux current parameter value.

2.3.26 Fan Curve

When Torque Perf Mode (53) is set to Fan/Pump V/Hz the relationship between frequency and voltage is a square function where the voltage is proportional to frequency. The fan curve provides the option to generate voltage that is a function of the stator frequency squared up to the motor nameplate frequency. Above base frequency, the voltage is a linear function of frequency. At low speed, the fan curve can be offset by the Run Boost (70) parameter to provide necessary starting torque.

2.3.27 Programmable Parameter Access Levels and Protection

The SP600 drive allows you to limit the number of parameters that can be viewed on the LCD OIM using an Access Level password. See section 10.3.1 for more information about this password.

You can also protect parameters from unauthorized changes by activating the Write Protect password. See section 10.4 for more information about this password.

2.3.28 User Sets

2.3.28.1 Normal Mode

After a drive has been configured for a given application, you can store a copy of all of the parameter settings in a specific EEPROM area known as a user set. Up to three user sets can be stored in the drive's memory to be used for backup, batch switching, or other needs. All parameter information is stored. You can then recall this data to the active drive operating memory as needed. Each user set can also be identified with a user-selected name.

You can use this feature using any of the following methods:

- Set parameters Load Frm Usr Set (198) and Save To User Set (199). Refer to the parameter descriptions in chapter 11.
- Program the function keys on the LCD OIM. Refer to section B.3.1 for this procedure.
- Access the Memory Storage menu on the LCD OIM. Refer to section B.7.2.

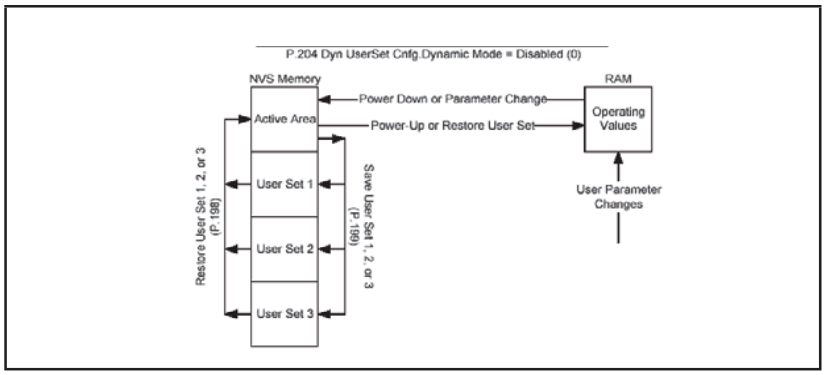


Figure 2.2 – Normal Mode Operation

2.3.28.2Dynamic Mode

Dynamic Mode Operation allows User Sets to be loaded by utilizing digital input states or by writing a value to a user set select parameter (205). In this mode, the active area will no longer exchange data with any User Set, but the operating memory will be directly loaded with any one of the three User Sets.

Important: User Sets must be properly setup in Normal Mode before they can be loaded and used in Dynamic Mode.

The method of writing the user set select parameter (205) value will allow a communications network to control which User Set is in use. Digital inputs can be configured to allow local control of User Sets from the drive's Terminal Block. Up to two digital inputs can be defined to allow selection of any combination of the three User Sets. Digital Inputs can be configured through Parameters 361 through 366.

The Dynamic Mode Operation User Set operation is enabled and disabled by a configuration parameter (204).

Important: Parameter writes are only recorded in the operating memory and not copied to non-volatile storage. Changes made to parameter values while Dynamic Mode is active will not be saved.

Parameter changes or power loss while Dynamic Mode is disabled (Normal Mode) will still automatically save changed data to active area non-volatile storage. Loading of User Set data to operating memory can occur only while the drive is in a stop condition. If a Dynamic Mode command from digital inputs occurs while the drive is running, the transfer of the selected User Set data will not occur until the drive is stopped, assuming that the Dynamic Mode and the transfer command are both still active when the drive stops. A Dynamic Mode command from the user set select parameter (205) while the drive is running will be immediately rejected.

Typical Setup / Operation:

Step 1. While in normal mode (Dyn UserSet Cnfg (204) = x0), enter data into drive and save to User Set using Save to User Set (199). Repeat for each needed User Set. Check that Dynamic User Set related Digital Inputs (parameters 361-366) and Datalink Inputs (parameters 300-307) are programmed the same in each.

Step 2. Enable Dynamic User Set Mode (Dyn UserSet Cnfg (204) = x1).

Step 3. Test restoring each programmed user Set via digital Inputs or DynUsrSetSel (205). If a Fault or Type 2 Alarm

occurs (Drive Alarm 2 (212) is non-zero), the User Set causing the error is loaded (see Dyn UserSet Actv (206) for indication). Return to Normal Mode (Dyn UserSet Cnfg (204) = x0), correct the Digital Input or Datalink definition(s), and save to the User Set that was loaded. Repeat step 2.

Step 4. Begin normal drive operation. Remember that User Sets can only be loaded while the drive is stopped.

At power-up, the drive will load operating memory with the values contained in the active non-volatile storage as part of initialization. If Dynamic Mode is Enabled, the selected User Set data will be loaded and processed after drive initialization completes but before the drive is allowed to become active. If Dynamic Mode is active and drive power is removed, User Set data will not be saved and any parameter changes will be lost.

When Dyn UserSet Cnfg (204) is set to Enabled, the drive will immediately transfer the selected User Set to operating memory as determined by digital inputs or DynUsrSetSel (205). The drive will verify that the User Set digital input configuration is identical in all three sets.

To avoid operational conflict between User Set values, all digital inputs must be set identically in each user set. If the digital inputs in each user set are not set identically, a Type 2 alarm is generated. The condition(s) must be corrected before the drive can become active.

Load Frm Usr Set (198) and Save to User Set (199) commands are not permitted in Dynamic Mode because these operations define data transfer between the active memory and the User Sets.

Disabling Dynamic Mode will cause the drive to operate in Normal Mode and parameter values will be transferred from operating memory into the active non-volatile storage area.

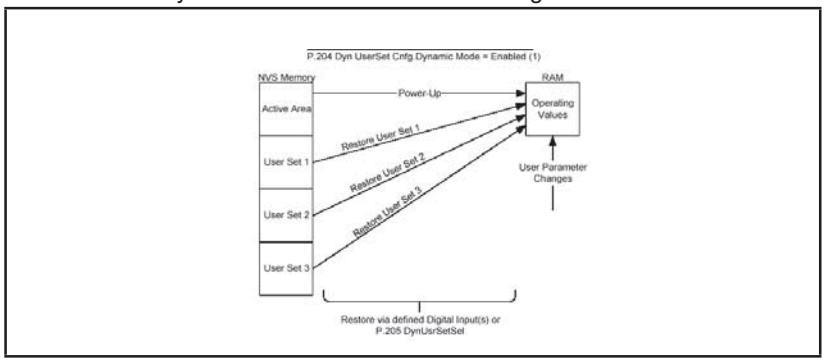


Figure 2.3 – Dynamic Mode Operation

2.4 CE Conformity

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. The 400 volt class SP600 AC drive complies with the EN standards listed below when installed according to this User Manual.

CE Declarations of Conformity are available online at: **http://www.reliance.com/certification**.

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations
- EN60204-1 Safety of machinery – Electrical equipment of machines

EMC Directive (89/336/EEC)

- EN61800-3 (Second Environment) Adjustable-speed electrical power drive systems Part 3: EMC product standard including specific test methods

General Notes

To be CE-compliant, the motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.

AC drives may cause radio interference. The user is required to take measures to prevent interference.

If the adhesive label is removed from the top of the drive, the drive must be mounted in a cabinet with side openings less than 12.5 mm (0.5 in) and top openings less than 1.0 mm (0.04 in) to maintain compliance with the Low Directive.

Conformity with CE EMC requirements does not guarantee that the entire machine or installation will comply with the requirements.

Use of line filters in ungrounded systems is not recommended.

2.4.1 Essential Requirements for CE Compliance

All conditions listed below must be satisfied for SP600 drives to meet the requirements of EN61800-3 for the Second Environment (Industrial).

- Standard SP600 CE-compatible drive.
- Grounding as described in section 5.3 if this manual.
- Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
- Cable length restrictions, common mode cores and filters per table 2.2.

Table 2.3 – SP600 AC Drive EN1800-3 EMC Compatibility

Frame	Drive Description	Second Environment	First Environment Restricted Distribution
2	Drive with any options	Restrict Motor Cable to 30 m (98 ft)	- Restrict Motor Cable to 150 m (492 ft) - Install external filter[1]
3	Drive with any options		
4 5 6	Drive with any options		(Not Available)

[1] Select the Deltron Emcom (http://www.deltron--emcom.com) filter (or equivalent) that meets your specifications from the list below.

Filter Part No.	Current	Filter Part No.	Current
MIF306	6 A	MIF350	50 A
MIF310	10 A	MIF375	75 A
MIF316	16 A	MIF3100	100 A
MIF323	23 A	MIF3150	150 A
MIF330	30 A		

2.5 Drive Connections

Figure 2.4 shows the locations of the drive terminal blocks and connectors used to set up and operate the drive. Table 2.3 identifies the drive connections shown with the corresponding number in figure 2.2.

Table 2.4 – Identification of Drive Connections

No.	Connector	Description
❶	Power Terminal Block	Connections for input and output power wiring.
❷	Signal and I/O Terminal Block	Connections for signal and I/O wiring. **Important:** The I/O board may be 24 VDC or 115 VAC. Check the model number on the drive nameplate.
❸	DPI Port 1	OIM connection.
❹	DPI Port 2	Connection for remote OIM or RECOMM-232 serial interface.
❺	DPI Port 5	Connection for optional communications module.

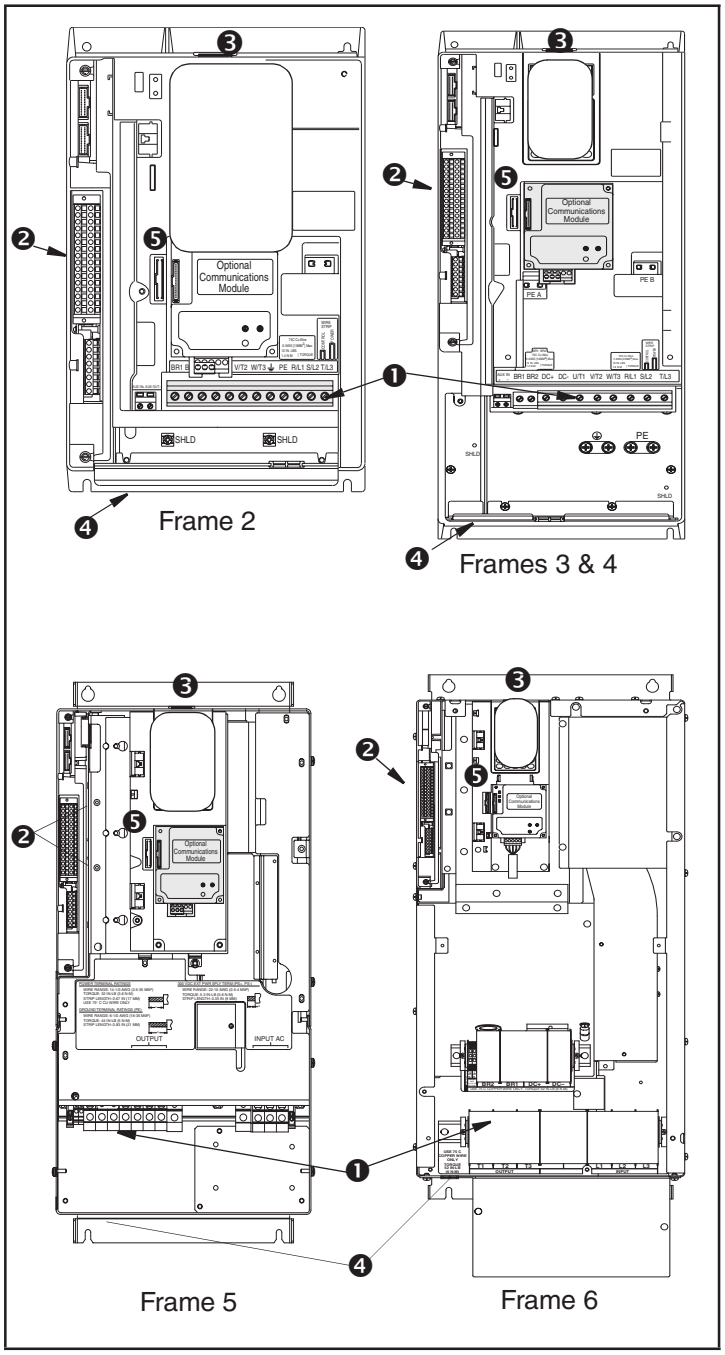


Figure 2.4 – Drive Connections

2.6 Drive Communication Options

The flat-ribbon cable connector (labeled ❺ in figure 2.2) is a parallel bus connection port that provides a means of attaching optional communication modules such as the DeviceNet Communication module to the SP600 AC drive.

Refer to the appropriate board instruction manual for more information. See table 2.5 for a list of available communication options.

Table 2.5 – Standard Kits and Options

Description	Model Number	Instruction Manual
DeviceNet Communication Module	RECOMM-DNET	D2-3478
Profibus Communication Module	RECOMM-PBUS	D2-3479
Interbus Communication Module	RECOMM-IBUS	D2-3480
ControlNet Communication Module	RECOMM-CNET	D2-3497
Ethernet/IP Communication Module	RECOMM-ENET	D2-3510
Modbus Communication Module	RECOMM-H485	VT-1001-2
RS485 DF1 Communication Module	RECOMM-485	D2-3514

2.7 Remote Operator Interface

The SP600 drive can be controlled and monitored using a remote LCD OIM (Operator Interface Module).

Table 2.6 – Remote OIM Model Number and Instruction Manual Number

Description	Model Number	Instruction Manual
Remote NEMA 4X LCD OIM	RE4LCD-PNL	D2-3490
Small Remote NEMA 4X LCD OIM	RE4ALCD	D2-3525

2.7.1 Connecting the Remote OIM or VS Utilities to the Drive

NEMA 1 Drives

The remote OIM connects to DPI port 2 at the bottom of the drive frame (labeled ❹ in figure 2.2). Note that you must change the appropriate parameters (89 and 90) to enable control from the remote keypad.

2.8 PC-Based Utility

The SP600 drive can be configured using a PC-based software utility such as VS Utilities. This program enables you to upload and download parameter configurations.

Table 2.7 – PC-Based Utility Model Number and Instruction Manual Number

Description	Model Number	Instruction Manual
VS Utilities	RECOMM-VSU232	D2-3488
Serial Converter (included with VS Utilities) for DPI Drives	RECOMM-232	D2-3477

CHAPTER 3

Mounting the Drive

This chapter provides information that must be considered when planning a SP600 AC drive installation and provides drive mounting information. Installation site requirements, drive requirements, and wiring requirements are presented.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Use of power correction capacitors on the output of the drive can result in erratic operation of the motor, nuisance tripping, and/or permanent damage to the drive. Remove power correction capacitors before proceeding. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

3.1 General Requirements for the Installation Site

It is important to properly plan before installing a SP600 AC drive to ensure that the drive's environment and operating conditions are satisfactory. Note that no devices are to be mounted behind the drive. If air-cooled devices are mounted near the drive, the hot air exhaust may raise the ambient temperature level above what is allowed for safe operation of the drive.

The area behind the drive must be kept clear of all control and power wiring. Power connections may create electromagnetic fields which may interfere with control wiring or components when run in close proximity to the drive. Read the recommendations in the following sections before continuing with drive installation.

3.1.1 Verifying Power Module AC Input Ratings Match Available Power

SP600 drives are suitable for use on a circuit capable of delivering up to a maximum of 200,000 rms symmetrical amperes, and a maximum of 600 volts (nominal).

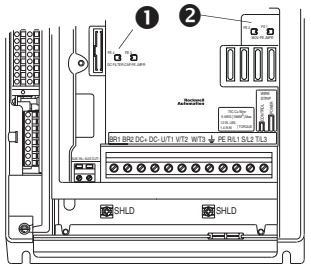
ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in section 4.4.

3.1.1.1 Unbalanced or Ungrounded Distribution Systems

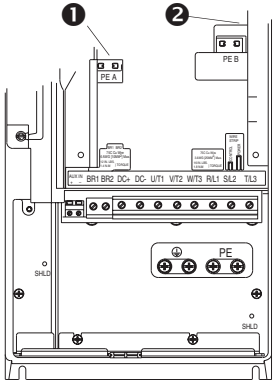
ATTENTION: SP600 drives contain protective MOVs and common mode capacitors that are referenced to ground. To guard against drive damage, these devices should be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: To avoid electric shock hazard, verify that the voltage on the bus capacitors has discharged before removing/installing jumpers. Measure the DC bus voltage at the +DC terminal of the Power Terminal Block and the -DC test point. The voltage must be zero.

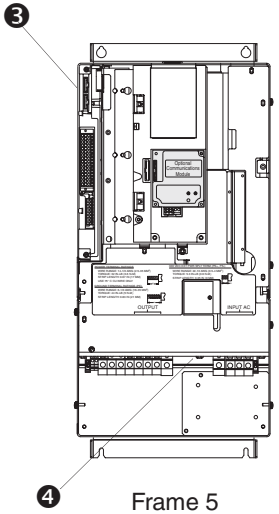
For ungrounded distribution systems, disconnect the MOVs and common mode capacitors by removing or disconnecting the jumper(s) shown in figure 3.1.



Frame 2



Frames 3 & 4



Frame 5

Frames	Jumper	Component	No.	Action
2-4	PEA	Common Mode Capacitors	1	Remove jumper located above the Power Terminal Block.
	PEB	MOV's	2	Same as above.
5	Wire	Common Mode Capacitors	3	Remove the I/O Cassette. The yellow/green jumper is located on the back of the chassis in the area shown. Disconnect, insulate and secure the wire to guard against unintentional contact with chassis or components.
		MOV's	4	
		Input Filter Capacitors		
6	Wire	Common Mode Capacitors		Remove the wire guard from the Power Terminal Block. Disconnect the three green/yellow wires from the two "PE" terminals shown. Insulate and secure the wires to guard against unintentional contact chassis or components.
		MOV's		
		Input Filter Capacitors		

Figure 3.1 – Typical Jumper Locations

3.1.1.2 Input Power Conditioning

If any of the following conditions exist, the use of a line reactor or isolation transformer is recommended.

- Frequent power outages
- Ungrounded AC supply source
- Facility has power factor correction capacitors
- Input voltage variations exceed drive operating specifications

3.1.1.3 AC Input Phase Selection (60HP and Larger)

Move the “Line Type” jumper as shown in figure 3.2 to select single or three-phase operation.

Important: When selecting single-phase operation, input power must be applied to the R (L1) and S (L2) terminals only.

3.1.1.4 Selecting/Verifying Fan Voltage (60HP and Larger)

Drives rated 60HP and larger use a transformer to match the input line voltage to the internal fan voltage. If your line voltage is different than the voltage class specified on the drive nameplate, it will be necessary to change the transformer tap as shown in figure 3.2. Common Bus (DC Input) drives require user supplied 120 or 240V AC to power the cooling fans. The power source is connected between “0 VAC” and the terminal corresponding to your source voltage.

The transformer is located behind the Power Terminal Block in the area shown in figure 3.2. Access is gained by releasing the terminal block from the rail. To release terminal block and change tap:

Step 1. Locate the small metal tab at the bottom of the end block.

Step 2. Press the tab in and pull the top of the block out. Repeat for next block if desired.

Step 3. Select appropriate transformer tap.

Step 4. Replace block(s) in reverse order.

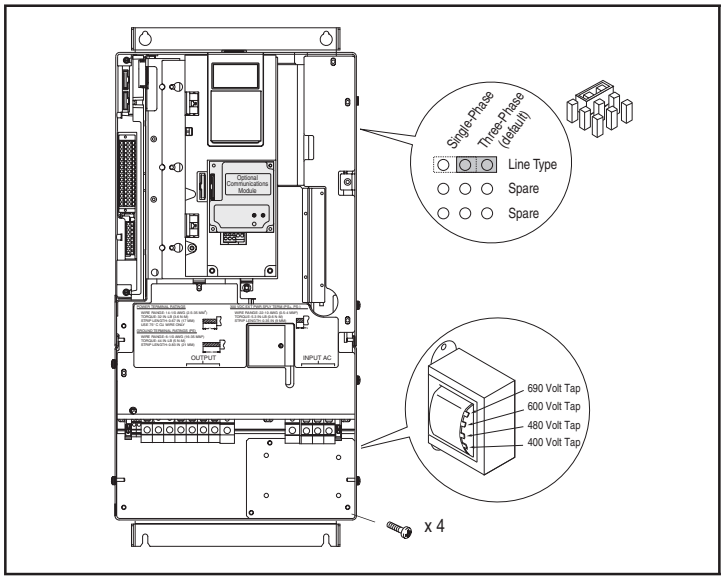


Figure 3.2 – Selecting Input Phase and Fan Voltage (60HP and Larger)

3.1.2 Making Sure Environmental Conditions are Met

Before deciding on an installation site, consider the following guidelines:

- Verify that NEMA 1 drives can be kept clean, cool, and dry.
- The area chosen should allow the space required for proper air flow as defined in section 3.1.3.
- Be sure that NEMA 1 drives are away from oil, coolants, or other airborne contaminants.
- Do not install the drive more than 3300 feet above sea level without derating output power. For every 300 feet above 3300 feet, derate the output current 1%.
- Verify that the drive location will meet the environmental conditions in Appendix A.

3.1.3 Minimum Mounting Clearances

Be sure there is adequate clearance for air circulation around the drive. For best air movement, do not mount SP600 AC drives directly above each other. Note that no devices are to be mounted behind the drive. This area must be kept clear of all control and power wiring. See figure 3.3 for recommended air flow clearances.

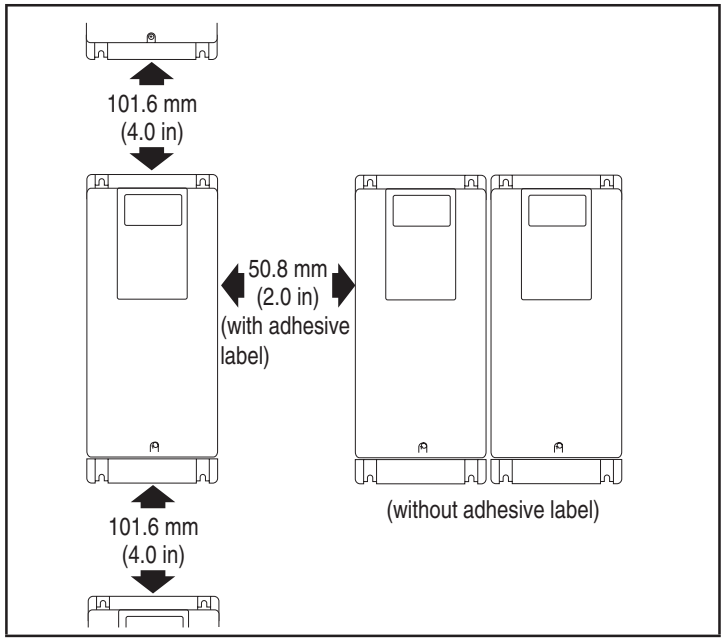
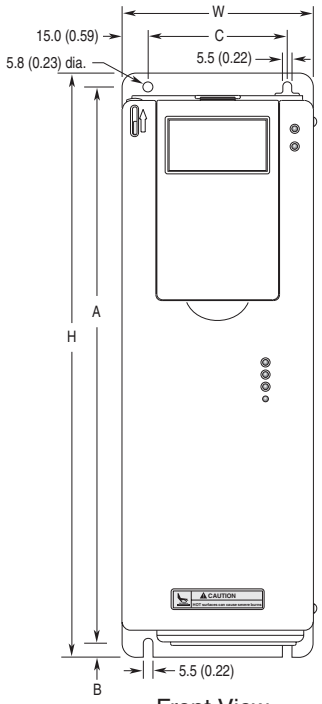


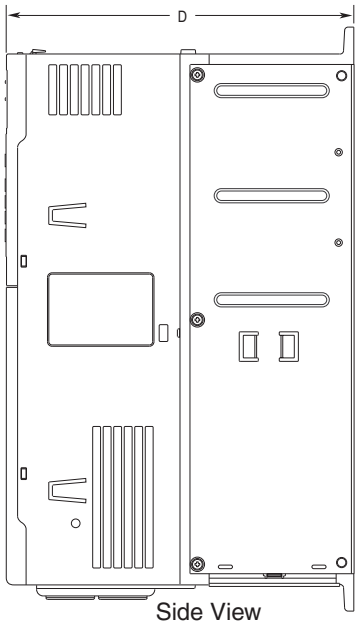
Figure 3.3 – Minimum Mounting Clearances

3.1.4 Drive Dimensions and Weights

Overall dimensions and weights are illustrated in figures 3.4, 3.5, 3.6, and 3.7 as an aid to calculating the total area required by the SP600 AC drive.



Front View

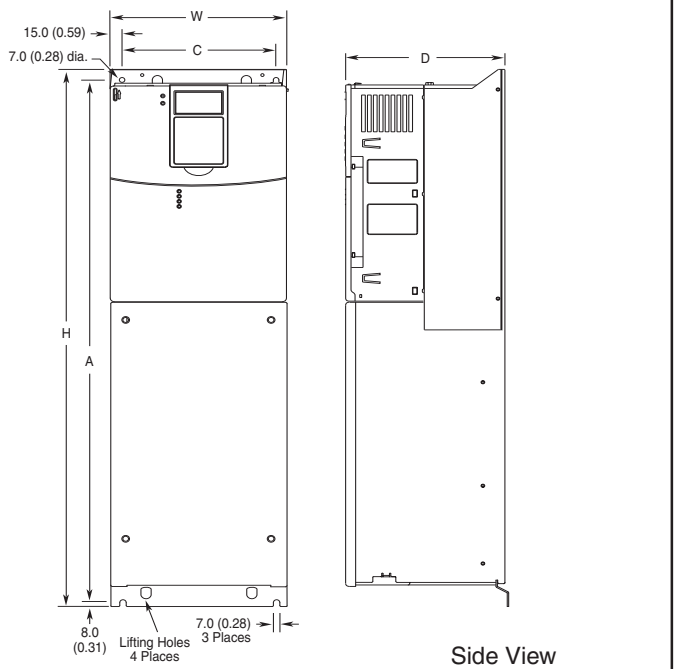


Side View

Dimensions in mm (in)
Weight in kg (lb)

Frame	HP	H	W	D	A	C	Weight
2	20 to 25 @ 460 VAC	342.5	222.0	200.0	320	192.0	12.52
	20 to 25 @ 575 VAC	(13.48)	(8.74)	(7.87)	(12.6)	(7.56)	(27.6)
3	30 to 50 @ 460 VAC	517.5	222.0	200.0	500	192.0	18.55
	30 to 50 @ 575 VAC	(20.37)	(8.74)	(7.87)	(19.7)	(7.56)	(40.9)

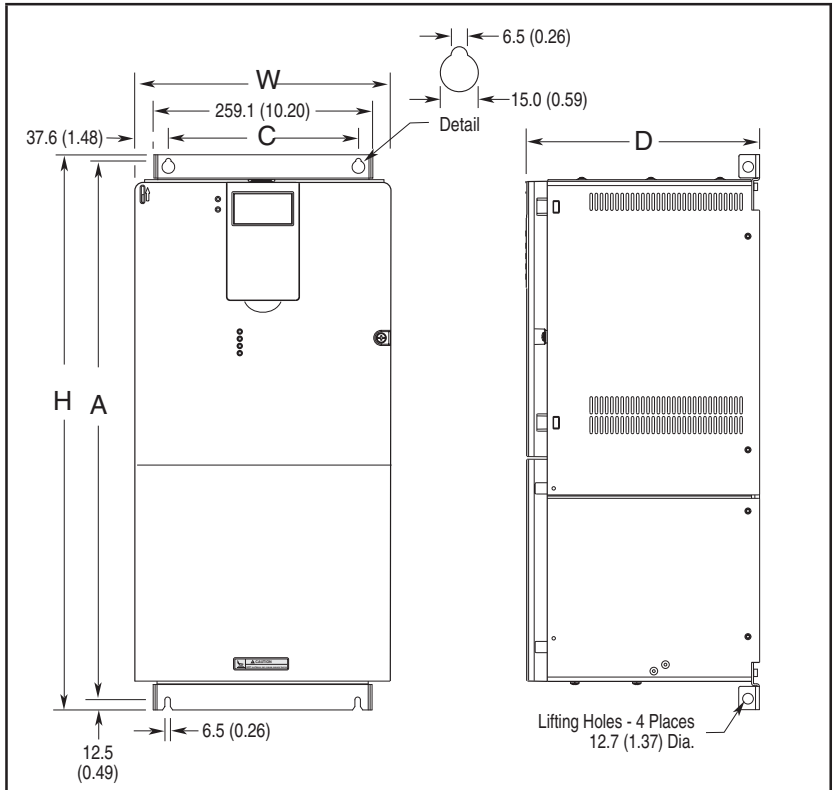
Figure 3.4 – Panel-Mount Drive Dimensions - Frames 2 and 3



Dimensions in mm (in)
Weight in kg (lb)

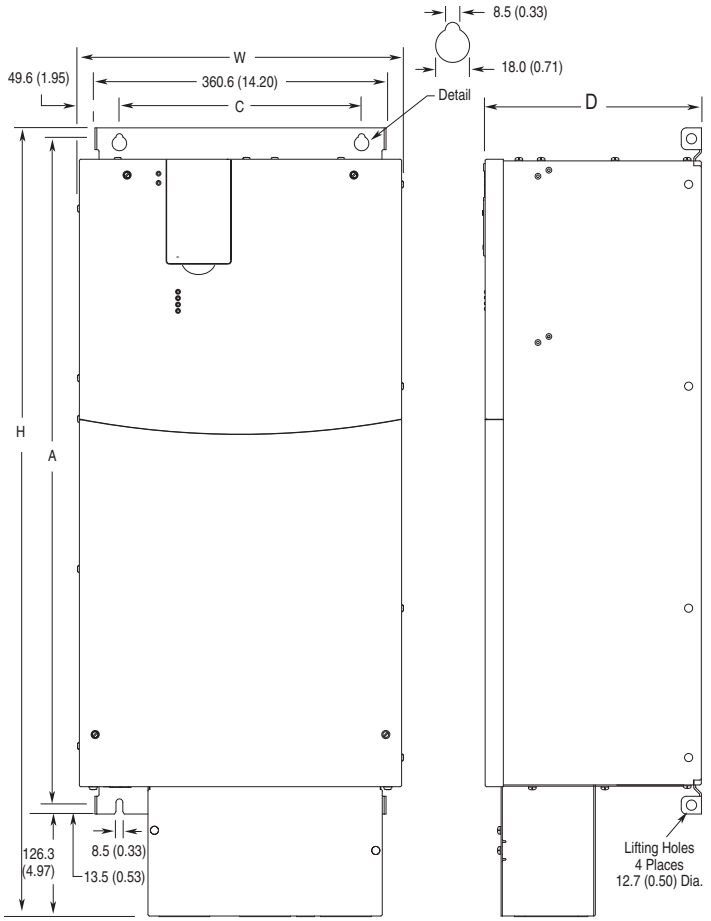
Frame	HP	H	W	D	A	C	Weight
4	60 @ 460 VAC	758.8	222.0	201.7	738.2	192.0	24.49
	60 @ 575 VAC	(29.87)	(8.66)	(7.94)	(29.06)	(7.56)	(54.0)

Figure 3.5 – Panel Mount Drive Dimensions - Frame 4



Frame	HP	H	W	D	A	C	Weight
5	60 to 100 HP @ 460 VAC 60 to 100 HP @ 575 VAC	644.5 (25.37)	308.9 (12.16)	275.4 (10.84)	625.0 (24.61)	225.0 (8.86)	37.19 (82.0)

Figure 3.6 – Panel-Mount Drive Dimensions - Frame 5



Frame	HP	H	W	D	A	C	Weight
6	125 to 150 HP @ 460 VAC 125 to 150 HP @ 575 VAC	976.3 (38.43)	403.9 (15.90)	275.5 (10.85)	825.0 (32.48)	300.0 (11.81)	71.44 (157.5)
6	200 HP @ 460 VAC 200 HP @ 575 VAC	976.3 (38.43)	403.9 (15.90)	275.5 (10.85)	825.0 (32.48)	300.0 (11.81)	75.07 (165.5)

Figure 3.7 – Panel-Mount Drive Dimensions - Frame 6

3.2 Mounting the Drive

Refer to figures 3.4, 3.5, 3.6, and 3.7 for drive mounting dimensions.

Attach the drive to the vertical surface using the mounting holes provided. Frame size 2 and 3 drives should be mounted using 3/16" (M5) bolts. Frame size 4 and 5 drives should be mounted using 1/4" (M6) bolts. Frame size 6 drives should be mounted using 5/16" (M8) bolts.

3.2.1 Verifying the Drive's Watts Loss Rating

When mounting the drive inside another enclosure, determine the watts loss rating of the drive from tables 2.1 and 2.2. This table lists the typical full load power loss watts value at a carrier frequency of 4 kHz. (The 248 amp drive is rated at a carrier frequency value of 2 kHz.) Ensure that the enclosure is adequately ventilated with 0° to 40° C (32° to 104° F) ambient air.

CHAPTER 4

Wiring Requirements for the Drive

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Wire size should be determined based on the size of conduit openings, and applicable local, national, and international codes, such as NEC/CEC. Evaluate wire sizes, branch circuit protection, and E-stop wiring before continuing with the drive installation.

4.1 Power Wiring

ATTENTION: National Codes and standards (NEC, VDE, BSI etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Cable Types Acceptable for 200-600 Volt Installations

General

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits.

As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than or equal to 15 mils (0.4mm/0.015 in.). See table 4.1.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas.** Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches, and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations, or a high degree of communications/networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics, and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket. See table table 4.1.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

Table 4.1 – Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90° C (194° F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	• Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90° C (194° F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	• Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

4.1.1 Power Wire Sizes

Input power wiring should be sized according to applicable codes to handle the drive's continuous-rated input current. Output wiring should be sized according to applicable codes to handle the drive's continuous-rated output current. See table 4.2 for the range of power wire sizes that the terminals can accommodate.

Table 4.2 – Power Terminal Block Specifications

Frame	Wire Size Range[1]		Torque
	Maximum	Minimum	
2	6 AWG	18 AWG	1.4 to 1.7 N-m (12 to 15 in-lb)
3	3 AWG	14 AWG	1.8 to 3.8 N-m (16 to 32 in-lb)
4	1/0 AWG	8 AWG	4.0 N-m (12 in-lb)
5 (60 to 75 HP)	1/0 AWG	12 AWG	(2)
5 (100 HP)	2/0 AWG	4 AWG	(2)
6	4/0 AWG	14 AWG	6.0 N-m (52 in-lb)

[1] Maximum/minimum sizes that the terminal block will accept. These are not recommendations.

[2] Refer to terminal block label inside drive.

4.1.2 Using Input/Output Contactors

Input Contactor Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If an input device is used, operation must not exceed one cycle per minute or drive damage will occur.

ATTENTION: The drive start/stop/enable control circuitry includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. An auxiliary braking method may be required.

Output Contactor Precaution

ATTENTION: To guard against drive damage when using output contactors, the following information must be read and understood. One or more output contactors may be installed between the drive and motor(s) for the purpose of disconnecting or isolating certain motors/loads. If a contactor is opened while the drive is operating, power will be removed from the respective motor, but the drive will continue to produce voltage at the output terminals. In addition, reconnecting a motor to an active drive (by closing the contactor) could produce excessive current that may cause the drive to fault. If any of these conditions are determined to be undesirable or unsafe, an auxiliary contact on the output contactor should be wired to a drive digital input that is programmed as "Enable." This will cause the drive to execute a coast-to-stop (cease output) whenever an output contactor is opened.

4.2 Control and Signal Wire Sizes

ATTENTION: Verify the voltage rating of the I/O interface board before wiring any user devices. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

The terminal block on the SP 600 I/O interface board provides terminals for 24 V or 115 VAC power for the control inputs, depending on the I/O card installed in the drive. Refer to 4.3 for signal and control wiring specifications.

Table 4.3 – Recommended Signal and Control Wire

Signal Type	Wire Type(s)	Description	Minimum Insulation Rating
Analog I/O	Belden 8760/ 9460 (or equiv.)	18 AWG, twisted pair, 100% shield with drain[1].	300V, 60°C (140°F)
	Belden 8770 (or equiv.)	18 AWG, 3-conductor, shielded for remote pot only.	
Unshielded Control	Per US NEC or applicable local code		300V, 60°C (140°F)
Shielded Control	Multi-conductor cable such as Belden 8770 (or equiv.)	18 AWG, 3-conductor shielded.	300V, 60°C (140°F)

[1] If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

4.3 Recommended Motor Lead Lengths

Important: To reduce line disturbances and noise, motor lead length should not exceed 300 feet for any non-Reliance Electric motor or any non-inverter duty motor.

The length of cable between the drive and motor may be limited for various applications reasons. The primary reasons are:

- Reflected wave
- Cable charging

Typically, motor lead lengths less than 91 m (300 ft) are acceptable. The primary concerns regarding cable length are cable charging and reflected wave (see section 4.3.1).

When total lead length exceeds 300 feet, nuisance trips can occur caused by capacitive current flow to ground. Note that these capacitively-coupled currents should be taken into consideration when working in areas where drives are running. If the motor lead length must exceed these limits, the addition of output line reactors (see section 6.3.1) or other steps must be taken to avoid problems.

Your application may be restricted to a shorter lead length due to:

- the type of wire (shielded or unshielded)
- the placement of wire (for example, in conduit or a cable tray)
- the type of line reactor
- the type of motor.
- carrier frequency.

Figure 4.1 illustrates how to calculate motor lead lengths. The examples shown assume a maximum lead length of 300 feet.

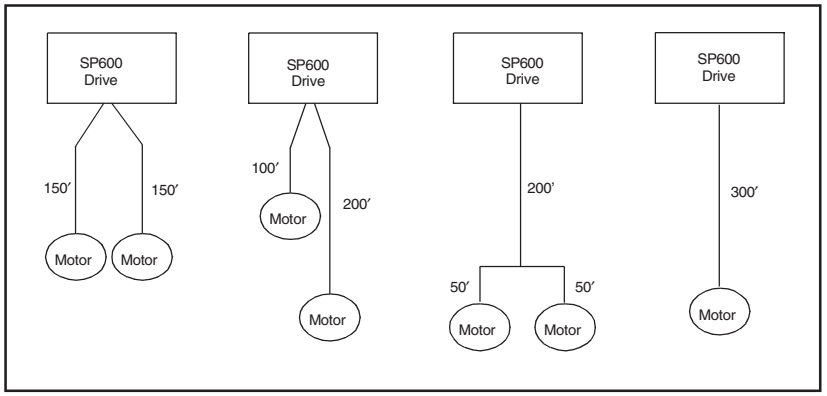


Figure 4.1 – How to Calculate Typical Motor Lead Lengths

4.3.1 Reflected Wave Compensation

You must understand the effects and restrictions when applying the drive to extended motor lead length applications. Proper cable type, motor and drive selection is required to minimize the potential risks.

The reflected wave phenomenon, also known as transmission line effect, produces very high peak voltages on the motor due to voltage reflection. Voltages in excess of twice the DC bus voltage, (650 V DC nominal @480 V input) result at the motor and can cause motor winding failure.

While Reliance Electric drives have patented software that limits the voltage peak to 2 times the DC bus voltage and reduce the number of occurrences, many motors have inadequate insulation systems to tolerate these peaks.

The correction software modifies the PWM modulator to prevent PWM pulses less than a minimum time from being applied to the motor. The minimum time between PWM pulses is 10 microseconds. The modifications to the PWM modulator limit the overvoltage transient to 2.25 per unit volts line-to-line peak at 600 feet of cable.

400 V Line = 540 V DC bus (max) x 2.25 = 1200 V
480 V Line = 715 V DC bus (max) x 2.25 = 1600 V
600 V Line = 891 V DC bus (max) x 2.25 = 2000 V

Parameter 56 is used to enable or disable this feature. Refer to the parameter description in chapter 11 for more information.

Figure 4.2 shows the inverter line-to-line output voltage (top trace) and the motor line-to-line voltage (bottom trace) for a 10 HP, 460 V AC inverter, and an unloaded 10 HP AC induction motor at 60 Hz operation. 500 ft. of #12 AWG PVC cable connects the drive to the motor.

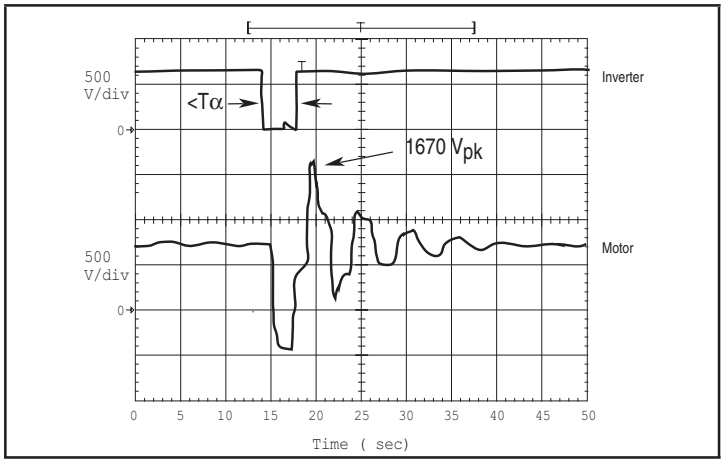


Figure 4.2 – Inverter and Motor Line-to-line Voltages

Initially, the cable is in a fully charged condition. A transient disturbance occurs by discharging the cable for approximately 4 ms. The propagation delay between the inverter terminals and motor terminals is approximately 1 ms. The small time between pulses of 4 ms does not provide sufficient time to allow the decay of the cable transient. Thus, the second pulse arrives at a point in the motor terminal voltage's natural response and excites a motor overvoltage transient greater than 2 pu.

The amplitude of the double pulsed motor over-voltage is determined by a number of variables. These include the damping characteristics of the cable, bus voltage, and the time between pulses, the carrier frequency, modulation technique, and duty cycle.

Figure 4.3 shows the per-unit motor overvoltage as a function of cable length. This is for no correction versus the modulation correction code for varied lengths of #12 AWG PVC cable to 600 feet for a 4 kHz and 8 kHz carrier frequencies. The output line-to-line voltage was measured at the motor terminals in 100 feet increments.

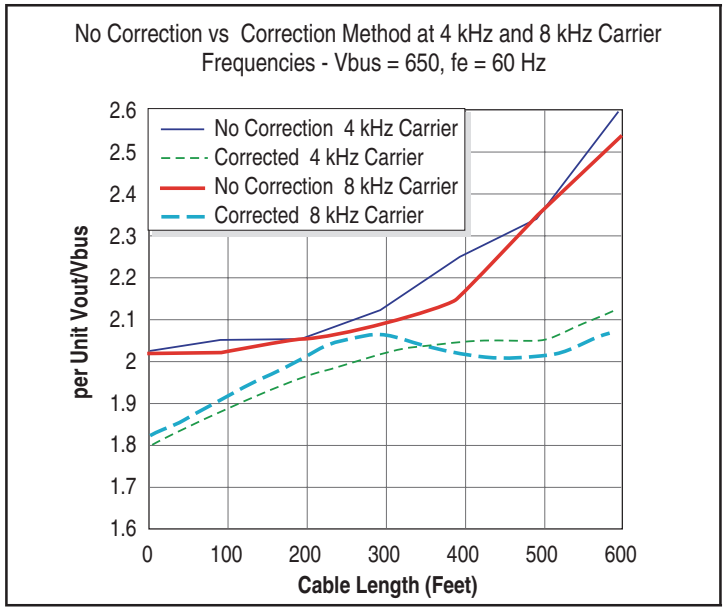


Figure 4.3 – Motor Overvoltage as a Function of Cable Length

Without the correction, the overvoltage increases to unsafe levels with increasing cable length for both carrier frequencies.

The patented modulation correction code reduces the overvoltage for both carrier frequencies and maintains a relatively flat overvoltage level for increasing cable lengths beyond 300 feet.

4.4 Selecting Input Line Branch Circuit Protection

ATTENTION: Most codes require that upstream branch circuit protection be provided to protect input power wiring. Install the fuses or circuit breakers recommended in table 4.4. Do not exceed the fuse ratings. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Input line branch circuit protection must be provided to protect the input power lines. Table 4.4 provides drive ratings (including continuous, 1 minute and 3 second) and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 degree C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

IEC – BS88 (British Standard) Parts 1 & 2, EN60269-1, Parts 1 & 2, type gG or equivalent should be used.

UL – UL Class CC, T, RK1 or J must be used.

Circuit Breakers

The circuit breaker listings in Table 4.4 are for inverse time circuit breakers.

IEC and UL – devices are acceptable for IEC and UL installations.

4.5 Verifying Power Module Output Current Rating is Greater than Motor Full Load Amps

Verify that the SP600 AC drive output current rating is greater than the motor's full load current (amps). Table 2.1 lists the output current values.

Table 4.4 – AC Line Input Fuse Selection Values

Model Number	Frame	Output Amps						Nominal Power Ratings				Dual Element Time Delay Fuse				Non-Time Delay Fuse				Circuit Breaker	
		480 VAC			400 VAC			110% OL Duty		150% OL Duty		480 VAC		400 VAC		480 VAC		400 VAC		480 VAC	400 VAC
		Cont	1 Min	3 Sec	Cont	1 Min	3 Sec	kW	HP	kW	HP	Min	Max	Min	Max	Min	Max	Min	Max	A	A
-027xxxxx	2	27	33	44	30	33	45	15	20	11	15	35	60	35	60	35	100	35	120	100	120
-034xxxx	2	34	40.5	54	37	45	60	18.5	25	15	20	40	70	45	80	40	125	45	125	125	125
-040xxxxx	3	40	51	68	43	56	74	22	30	18.5	25	50	90	60	90	50	150	60	150	150	150
-052xxxxx	3	52	60	80	56	64	86	30	40	22	30	60	110	70	125	60	200	70	200	200	200
-065xxxxx	3	65	78	104	72	84	112	37	50	30	40	75	125	90	150	75	250	90	250	250	250
-077xxxxx	4	77	97.5	130	85	128	170	45	60	37	50	100	170	110	200	100	300	110	300	300	300
-096xxxxx	5	96	106	144	105	116	158	55	75	45	60	125	200	125	225	125	350	125	400	350	300
-125xxxxx	5	125	138	163	125	138	163	55	100	66	75	150	250	150	275	150	500	150	500	375	375
-156xxxxx	6	156	172	234	170	187	255	93	125	75	100	200	350	250	375	200	600	250	600	450	500
-180xxxxx	6	180	198	270	205	220	289	110	150	110	125	225	400	250	450	225	600	250	600	500	600
-248xxxxx	6	248	273	372	260	236	390	132	200	110	150	300	550	350	550	300	700	350	750	700	750

Table 4.5 – AC Line Input Fuse Selection Values

Model Number	Frame	Output Amps			Nominal Power Ratings				Dual Element Time Delay Fuse		Non-Time Delay Fuse		Circuit Breaker
		575 VAC			110% OL Duty		150% OL Duty		575 VAC		575 VAC		575 VAC
		Cont	1 Min	3 Sec	kW	HP	kW	HP	Min	Max	Min	Max	A
-022xxxxx	2	22	25.5	34	15	20	11	15	30	50	30	80	80
-027xxxxx	2	27	33	44	18.5	25	15	20	35	60	35	100	100
-032xxxxx	3	32	40.5	54	22	30	18.5	25	40	70	40	125	125
-041xxxxx	3	41	48	64	30	40	22	30	50	90	50	150	150
-052xxxxx	3	52	61.5	82	37	50	30	40	60	110	60	200	200
-062xxxxx	4	62	78	104	45	60	37	50	80	125	80	225	225
-077xxxxx	5	77	85	116	55	75	-	-	90	150	90	300	300
		63	94	126	-	-	45	60	90	125	90	250	250
-099xxxxx	5	99	109	126	75	100	-	-	125	200	125	375	375
		77	116	138	-	-	55	75	100	175	100	300	300
-125xxxxx	6	125	138	188	90	125	-	-	150	250	150	375	375
		99	149	198	-	-	75	100	125	200	125	375	375
-144xxxxx	6	144	158	216	110	150	-	-	175	300	175	400	400
		128	188	250	-	-	90	125	150	275	150	375	375

CHAPTER 5

Finding Wire-Routing Locations and Grounding

This chapter shows entry areas where wiring is to be routed in and out of the drive and how to properly ground it.

5.1 Routing Input, Motor Output, Ground, and Control Wiring for the Drive

All wiring must be installed in conformance with applicable local, national, and international codes, such as NEC/CEC. Signal wiring, control wiring, and power wiring must be routed in separate conduits to prevent interference with drive operation.

Note that no wires are to be routed behind the drive. Use grommets, when hubs are not provided, to guard against wire chafing.

Figure 5.1 shows the wire routing, grounding terminal, and power terminal blocks of the SP600 AC drive.

ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Do not route more than three sets of motor leads through a single conduit. This will minimize cross-talk that could reduce the effectiveness of noise reduction methods. If more than three drive/motor connections per conduit are required, shielded cable must be used. If possible, each conduit should contain only one set of motor leads.

ATTENTION: Unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages. Also, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled to eliminate the possible shock hazard from cross-coupled motor leads. Failure to observe these precautions could result in bodily injury.

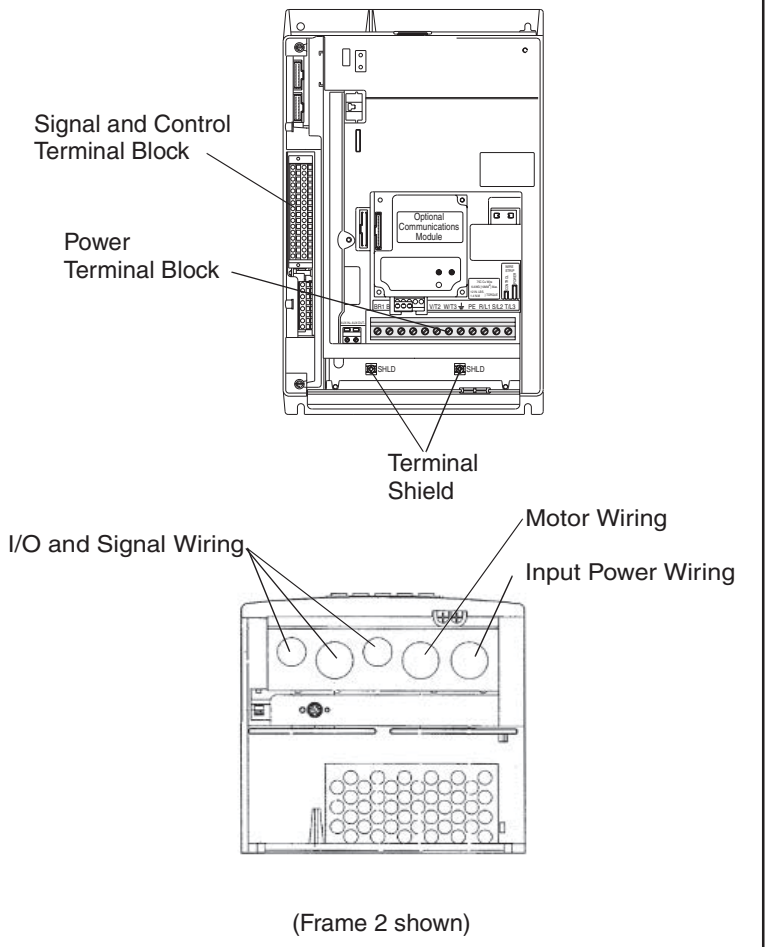


Figure 5.1 – Wire Routing and Terminal Block Locations (Frame 2 Shown)

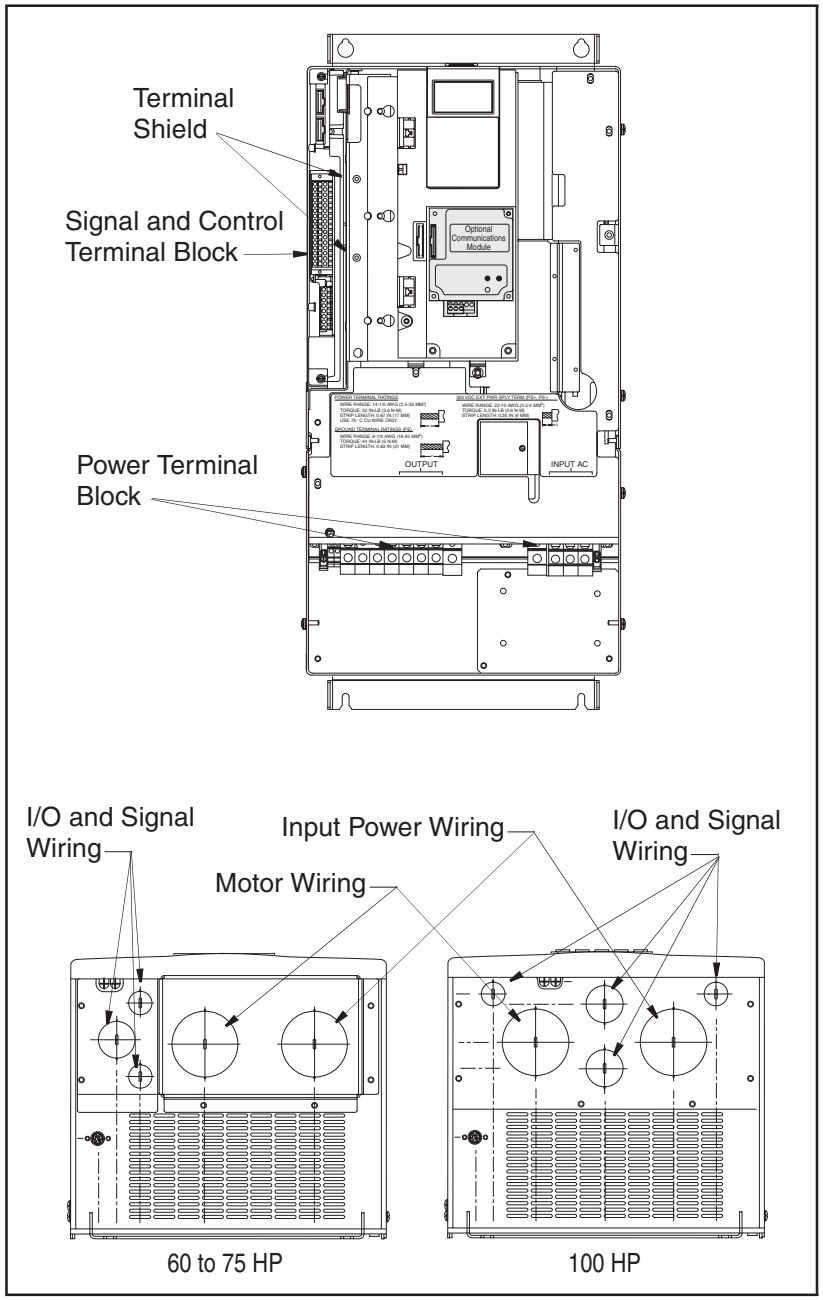


Figure 5.2 – Wire Routing and Terminal Block Locations (Frame 5 Shown)

5.2 Grounding the Drive

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

If the supply system is grounded, the drive Safety Ground - PE terminal must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

For installations within a cabinet, a single safety ground point or ground bus bar connected directly to building steel should be used. All circuits including the AC input ground conductor should be grounded independently and directly to this point/bar.

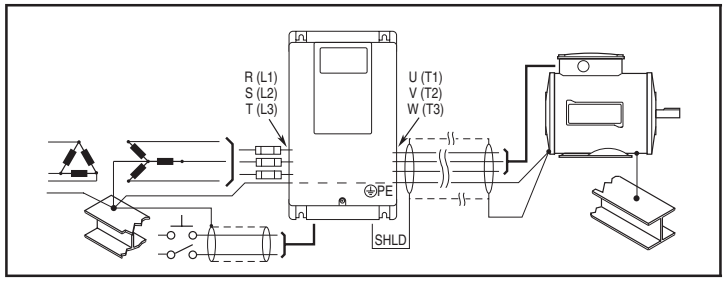


Figure 5.3 – Typical Grounding

Safety Ground - PE

This is the safety ground for the drive that is required by code. This point must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar (see figure 5.3 and figure 5.4). Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Shield Termination - SHLD

The SHLD terminal located on the Cable Entry Plate provides a grounding point for the motor cable shield. Refer to figure 5.1 or figure 5.2 for location.

The motor cable shield connected to this terminal on the Cable Entry Plate (drive end) should also be connected to the motor frame (motor end). Use a shield-terminating or EMI clamp to connect shield to this terminal.

When shielded cable is used for control and signal wiring, the shield should be grounded at the source end only, not at the drive end.

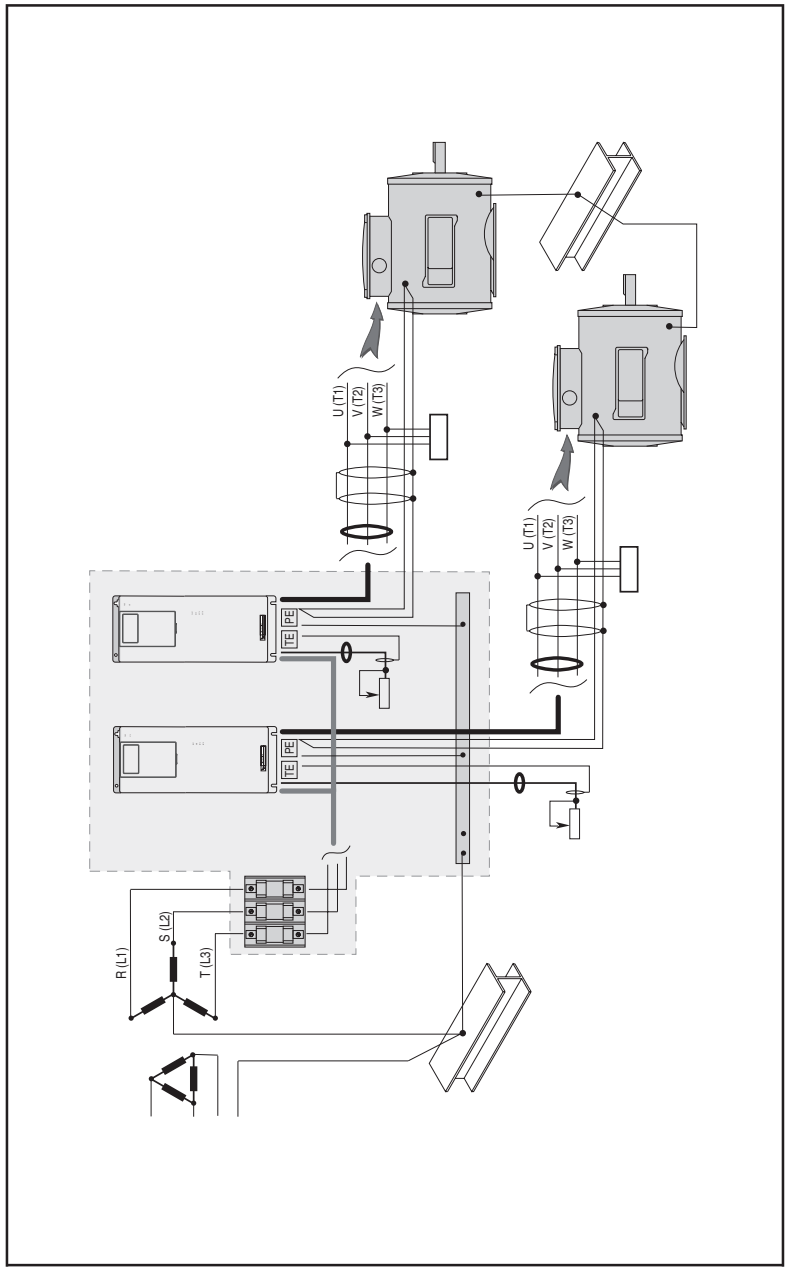


Figure 5.4 – Single-Point Grounding/Panel Layout

CHAPTER 6

Installing Power Wiring

ATTENTION: The user is responsible for conforming with all applicable local and national codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

This chapter provides instructions on output wiring to the motor and installing AC input power wiring. Refer to figure 6.2 at the end of this chapter for a description of the power terminal block.

6.1 Opening the Cover

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been removed. After disconnecting input power, wait five minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

Follow these steps to open the drive cover.

Step 1. Locate the slot in the upper left hand corner of the drive (see figure 6.1).

Step 2. Slide the locking tab up and swing the door open.

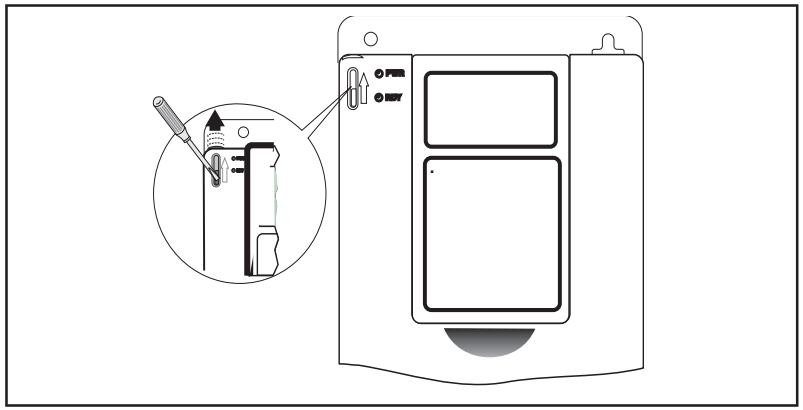


Figure 6.1 – Opening the Drive Cover

6.2 Installing Output Power Wiring

ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe these precautions could result in damage to, or destruction of, the equipment

ATTENTION: Unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages. Also, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled to eliminate the possible shock hazard from cross-coupled motor leads. Failure to observe these precautions could result in bodily injury.

To connect the AC output power wiring from the drive to the motor:

Step 1. Wire the three-phase AC output power motor leads by routing them according to drive type. See figure 5.1 to for wire routing locations. Maximum power wiring sizes are shown in table 4.1.

Do not route more than three sets of motor leads through a single conduit. This will minimize cross-talk that could reduce the effectiveness of noise reduction methods. If more than three drive/motor connections per conduit are required, shielded cable must be used. If possible, each conduit should contain only one set of motor leads.

Step 2. Connect the three-phase AC output power motor leads to terminals U/T1, V/T2, and W/T3 on the power terminal block. See figure 6.2.

Step 3. Tighten the three-phase AC output power terminals to the proper torque according to drive type as shown in table 6.1.

Table 6.1 – Terminal Tightening Torques

Frame	Maximum Tightening Torque
2	1.7 N-m (15 in-lb)
3	3.6 N-m (32 in-lb)
4	4.0 N-m (35 in-lb)
5	(1)
6	6.0 N-m (52 in-lb)

1 Refer to terminal block label inside drive.

6.3 Installing Input Wiring

Sections 6.3.1 to 6.3.4 describe incoming line components and how to install them.

6.3.1 Installing an Optional Transformer and Reactor

Input isolation transformers might be needed to help eliminate:

- Damaging AC line voltage transients from reaching the drive.
- Line noise from the drive back to the incoming power source.
- Damaging currents that could develop if a point inside the drive becomes grounded.

Observe these guidelines when installing an isolation transformer:

- A power disconnecting device must be installed between the power line and the primary of the transformer.
- If the user-installed power disconnecting device is a circuit breaker, the circuit breaker trip rating must be coordinated with the in-rush current (10 to 12 times full load current) of the transformer.
- Do not use an input isolation transformer rated more than 1000 KVA for 480 VAC with less than 5% impedance directly ahead of the drive without additional impedance between the drive and the transformer.

Table 6.2 shows recommended inductance and line reactor ratings.

Table 6.2 – AC Line Reactors

Drive (HP)	Line Reactor Inductance (±10%)	Reactor Rating (kVAr)
20	0.8 mH	1.04
25	0.8 mH	1.04
30	0.7 mH	1.04
40	0.5 mH	1.43
50	0.4 mH	1.90
60	0.4 mH	1.90
75	0.3 mH	2.76
100	0.2 mH	2.76
125	0.12 mH	2.76
150	0.11 mH	not available
200	0.09 mH	not available

6.3.2 Installing Fuses for Branch Circuit Protection

Install the required branch circuit protection fuses according to the applicable local, national, and international codes (such as NEC/CEC). The fuses or approved circuit breaker must be installed in the line before the drive input terminals. Fuse values are provided in table 4.3.

ATTENTION: Most codes require that upstream branch protection be provided to protect input power wiring. Failure to observe this precaution could result in severe bodily injury or loss of life.

6.3.3 Installing the Required Input Disconnect

An input disconnect must be installed in the line before the drive input terminals in accordance with local, national, and international codes, such as NEC/CEC. The disconnect should be sized according to the in-rush current as well as any additional loads the disconnect might supply. The trip rating for the in-rush current (10 to 12 times full load current) should be coordinated with that of the input isolation transformer, if used.

6.3.4 Installing Power Wiring from the AC Input Line to the Drive's Power Terminals

ATTENTION: Protect the contents of the cabinet from metal chips and other debris while drilling the conduit openings. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

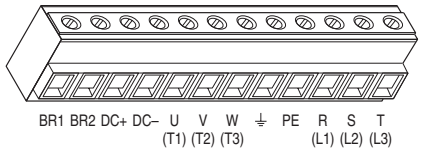
ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

To connect AC input power to the drive:

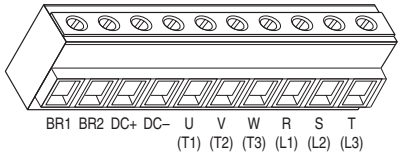
Step 1. Wire the AC input power leads by routing them according to drive type. Refer to figure 5.1. Maximum power wiring sizes are listed in table 4.1.

Step 2. Connect the three-phase AC input power leads to the appropriate terminals. Connect the AC input power leads to terminals R/L1, S/L2, T/L3 on the power terminal block (see figure 6.2).

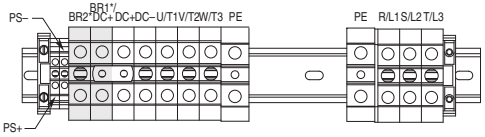
Step 3. Tighten the AC input power terminals to the proper torque as shown in table 6.1.



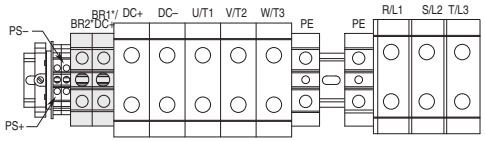
Frame 2



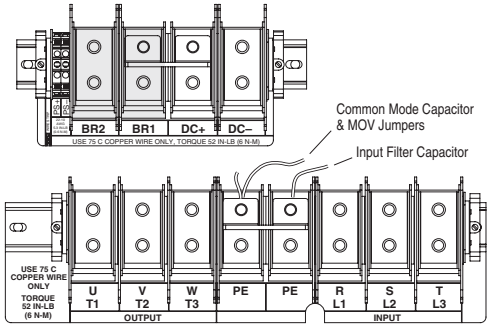
Frames 3 & 4



Frame 5 (75 HP)



Frame 5 (100 HP)



Frame 6 (125,150, 200 HP)

Figure 6.2 – Power Terminal Block

Table 6.3 – Power Terminal Descriptions

Terminal	Description	Notes
BR1	DC Brake	Dynamic brake resistor connection (+)
BR2	DC Brake	Dynamic brake resistor connection (–)
DC+	DC Bus (+)	DC bus test point (+)
DC–	DC Bus (–)	DC bus test point (–)
U	U (T1)	Output to Motor
V	V (T2)	Output to Motor
W	W (T3)	Output to Motor
⏚ [1]	Ground	
PE[1]	PE Ground	Earth Ground
R	R (L1)	AC line input power
S	S (L2)	AC line input power
T	T (L3)	AC line input power

[1] Frame 2 only.

CHAPTER 7

Installing Control Wiring

This chapter describes how to wire the signal and I/O terminal strip for stop, speed feedback, and remote control signals. Wiring of the terminal block is detailed in table 7.1.

7.1 Stop Circuit Requirements

ATTENTION: You must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation can result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

Depending upon the requirements of the application, the SP600 AC drive can be configured to provide either a coast-to-rest or a ramp-to-rest operational stop without physical separation of the power source from the motor. A coast-to-rest stop turns off the transistor power device drivers. A ramp-to-rest stop fires the transistor power device drivers until the motor comes to a stop, and then turns off the power devices.

In addition to the operational stop, you must provide a hardwired emergency stop external to the drive. The emergency stop circuit must contain only hardwired electromechanical components. Operation of the emergency stop must not depend on electronic logic (hardware or software) or on the communication of commands over an electronic network or link.

Note that the hardwired emergency stop you install can be used at any time to stop the drive.

7.1.1 User-Initiated Stopping

ATTENTION: Note the following about stop commands:

- A stop command from any attached OIM will always be enabled regardless of the value of Logic Source Sel (parameter 89).
- Network stop commands are effective only when Logic Source Sel is set to Network or All Ports.
- Terminal block stop commands are effective only when Logic Source Sel is set to Terminal Blk or All Ports.

Failure to observe these precautions could result in severe bodily injury or loss of life.

The terminal block Drive Enable input and the Function Loss input, if configured, are always active. This is independent of the Logic Source Select setting. The terminal block Stop input must be closed only when the terminal block is the logic source. See figure 7.1.

7.2 Control and Signal Inputs

The drive has six logic inputs that are configurable using parameters 361 to 366. The logic inputs can be 24 V or 115 VAC, depending on the interface board installed in the drive.

There are two relay outputs that are configurable using parameters 380 to 387, two analog inputs, and one analog output.

7.3 Removing the I/O Terminal Block

Step 1. Open the drive cover.

Step 2. Grip the I/O terminal at the top and bottom, and pull straight out.

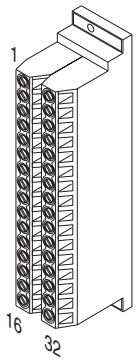
Step 3. After wiring the terminal block, align the pins and press the terminal block back into place.

7.4 Wiring the Signal and Control I/O

Important: Two I/O boards are available: 24V AC/DC logic and 115 VAC logic. Verify which board is used in your drive before wiring the signal and control I/O terminal block.

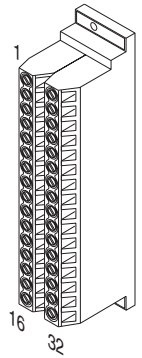
Wire the drive's signal and control I/O to the terminal block as shown in table 7.1.

Table 7.1 – Wiring Signal and Control I/O to the Terminal Block



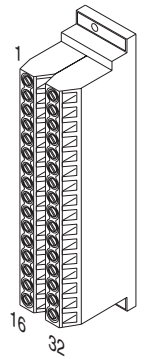
No.	Signal	Factory Default	Description	Related Param.
Analog Inputs				
1	Anlg Volts In 1 (–)	1	Isolated[2], bipolar, differential, ±10 V, 11 bit & sign, 100k ohm input impedance.	320 - 329
2	Anlg Volts In 1 (+)			
3	Anlg Volts In 2 (–)	1	Isolated [3], bipolar, differential, ±10 V, 11 bit & sign, 100k ohm input impedance.	
4	Anlg Volts In 2 (+)			
5	Potentiometer Common	–	For (+) and (–) 10 V pot references.	
Analog Output				
6	Anlg Volts Out 1 (–)	Output Freq[1]	Bipolar, differential, ±10 V, 11 bit & sign, 2k ohm minimum load.	340 - 344
7	Anlg Volts Out 1 (+)			
8	Anlg Current Out 1 (–)	1	4-20 mA, 11 bit & sign, 400 ohm maximum load.	
9	Anlg Current Out 1 (+)			
10	Reserved			
Digital Outputs				

Table 7.1 – Wiring Signal and Control I/O to the Terminal Block



No.	Signal	Factory Default	Description	Related Param.
11	Digital Out 1 – N.C.	Fault	Resistive Load Rating: 2 A at 250 V AC/30 V DC Min. Load: 10 mA Inductive Load Rating: 2 A at 250 V AC/30 V DC Min. Load: 10 mA	380 - 387
12	Digital Out 1 Common			
13	Digital Out 1 – N.O.			
14	Digital Out 2 – N.C.	Running		
15	Digital Out 2 Common			
16	Digital Out 2 – N.O.			
Analog Inputs				
17	Anlg Current In 1 (–)	[1]	Isolated[2], 4-20 mA, 11 bit & sign, 124 ohm input impedance.	320 - 329
18	Anlg Current In 1 (+)			
19	Anlg Current In 2 (–)	[1]	Isolated[2], 4-20 mA, 11 bit & sign, 124 ohm input impedance.	
20	Anlg Current In 2 (+)			
Voltage Reference Supplies				
21	–10V Pot Reference	n/a	2k ohm minimum, 15 mA maximum load.	
22	+10V Pot Reference	n/a		
23	Reserved			
24	+24VDC	n/a	Drive supplied power for logic inputs. 150 mA maximum Load.	
Voltage Reference Supplies (cont.)				
25	Digital In Common	n/a		

Table 7.1 – Wiring Signal and Control I/O to the Terminal Block



No.	Signal	Factory Default	Description	Related Param.
26	24V Power Supply Common (internal)	n/a	Drive supplied power for logic inputs. 150 mA maximum Load.	
Digital Inputs				
27	Digital In1	Stop/CF	24V AC/DC I/O Board Opto isolated (250 V) Low state: less than 5 V AC High State: greater than 10 V AC 115 VAC I/O Board[4] Opto isolated (250 V) Low state: less than 10 V AC High State: greater than 100 V AC	361 - 366
28	Digital In2	Start		
29	Digital In3	Function Loss		
30	Digital In4	Jog		
31	Digital In5	Auto/ Manual		
32	Digital In6	Speed Select		

[1] These inputs/outputs are dependent on a number of parameters. See “Related Parameters” column.

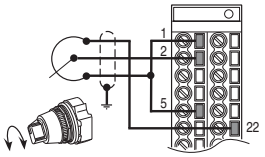
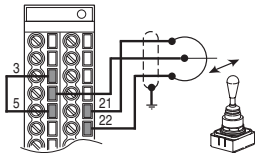
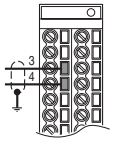
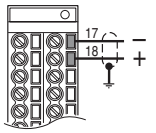
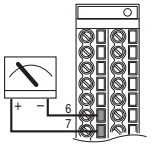
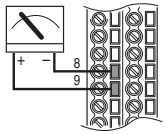
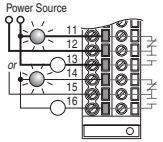
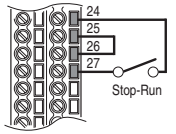
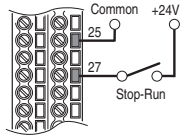
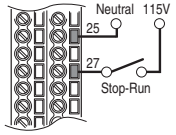
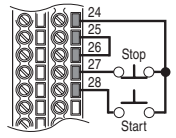
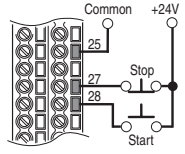
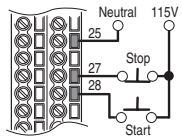
[2] Differential Isolation - External source must be maintained at less than 160 V with respect to PE. Input provides high common mode immunity.

[3] Differential Isolation - External source must be less than 10 V with respect to PE.

[4] Drive Model with 115V interface required. See figure 2.1.

7.5 I/O Wiring Examples

ATTENTION: Noise and drift in sensitive bipolar input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

Input/Output	Connection Example		
Unipolar[1] 10k Ohm Pot. Recommended (2k Ohm Minimum) **Bipolar**[1] ±10V Input	Potentiometer	Joystick	
			
Analog Input ±10V Input - 100k ohm input impedance. 4-20 mA Input - 100 ohm input impedance	Voltage - Bipolar[1]	Current - Unipolar	
			
Analog/Digital Output ±10V Output - Can drive a 10k ohm load (25 mA short circuit current limit).	Voltage	Current	Logic
			
2 Wire Control[2] **- Non-Reversing** Requires 2-wire functions only (Digital In1 Sel). Using 3-wire selections will cause a type 2 alarm.	24VDC Internal Supply	24VDC External Supply	115V External Source[3]
			
3 Wire Control Requires only 3-wire functions (Digital In1 Sel). Including 2-wire selections will cause a type 2 alarm.	24VDC Internal Supply	24VDC External Supply	115V External Source
			

1 Refer to the Attention statement at the top of this page for important bipolar wiring information.

2 **Important:** Programming inputs for 2-wire control deactivates all OIM Start buttons.

3 Drive Model with 115V interface required. See figure 2.1.

7.6 Wiring Diagram - Control and Motor

ATTENTION: Opening the Function Loss input (3, 9) will stop the drive. You must ensure that all terminal strip inputs are wired properly for your drive configuration. Failure to observe this precaution could result in severe bodily injury or loss of life.

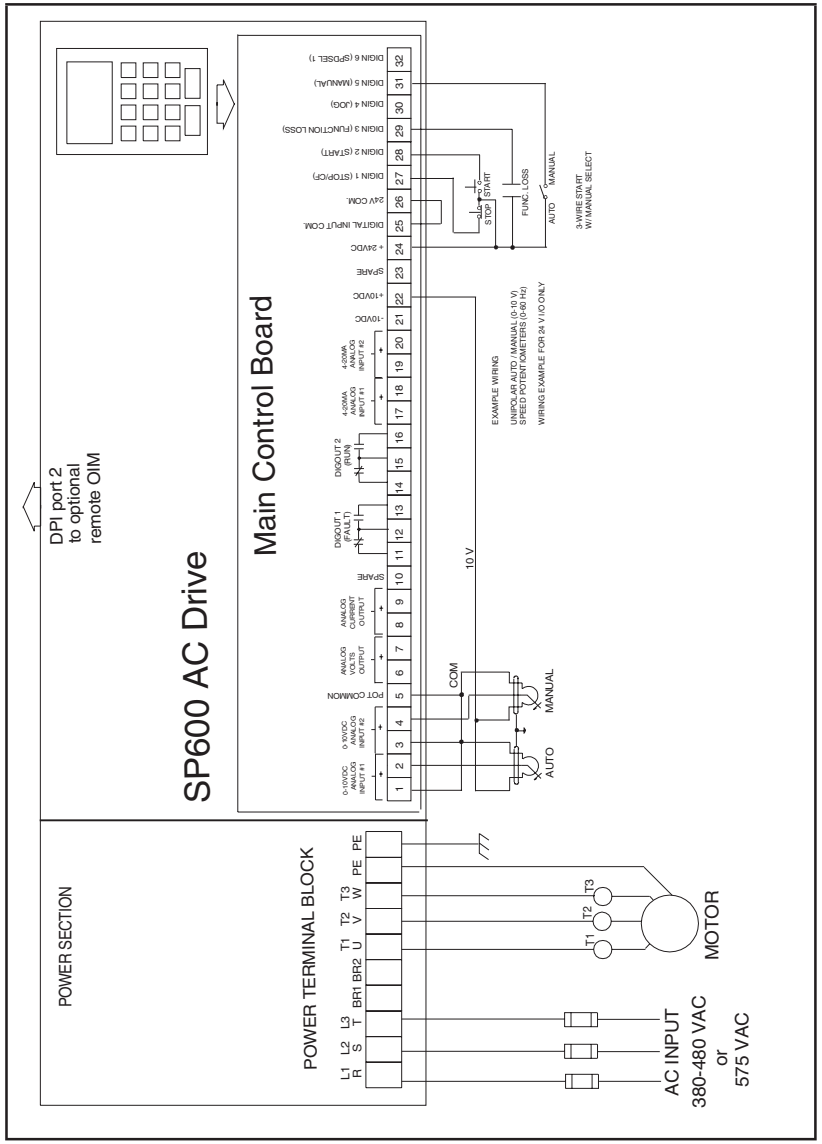


Figure 7.1 – Typical Wiring Diagram

Param. Number	Description	Value	Param. Number	Description	Value
90	Spd Ref A	Anlg #1	325	Anlg In 2 Hi	10 V
91	Spd Ref A Hi	60 Hz	326	Anlg In 2 Lo	0 V
92	Spd Ref A Lo	0 Hz	361	Dig In 1 Sel	Stop
96	TB Man Ref	Anlg #2	362	Dig In 2 Sel	Start
97	TB Man Ref Hi	60 Hz	363	Dig In 3 Sel	Func. Loss
98	TB Man Ref Lo	0 Hz	364	Dig In 4 Sel	
320	Analog Conf	xxx.xx00	365	Dig In 5 Sel	Manual
322	Anlg In 1 Hi	10 V	366	Dig In 6 Sel	
323	Anlg In 1 Lo	0 V			

Table 7.2 – Parameter Configuration for Figure 7.1 Wiring Example

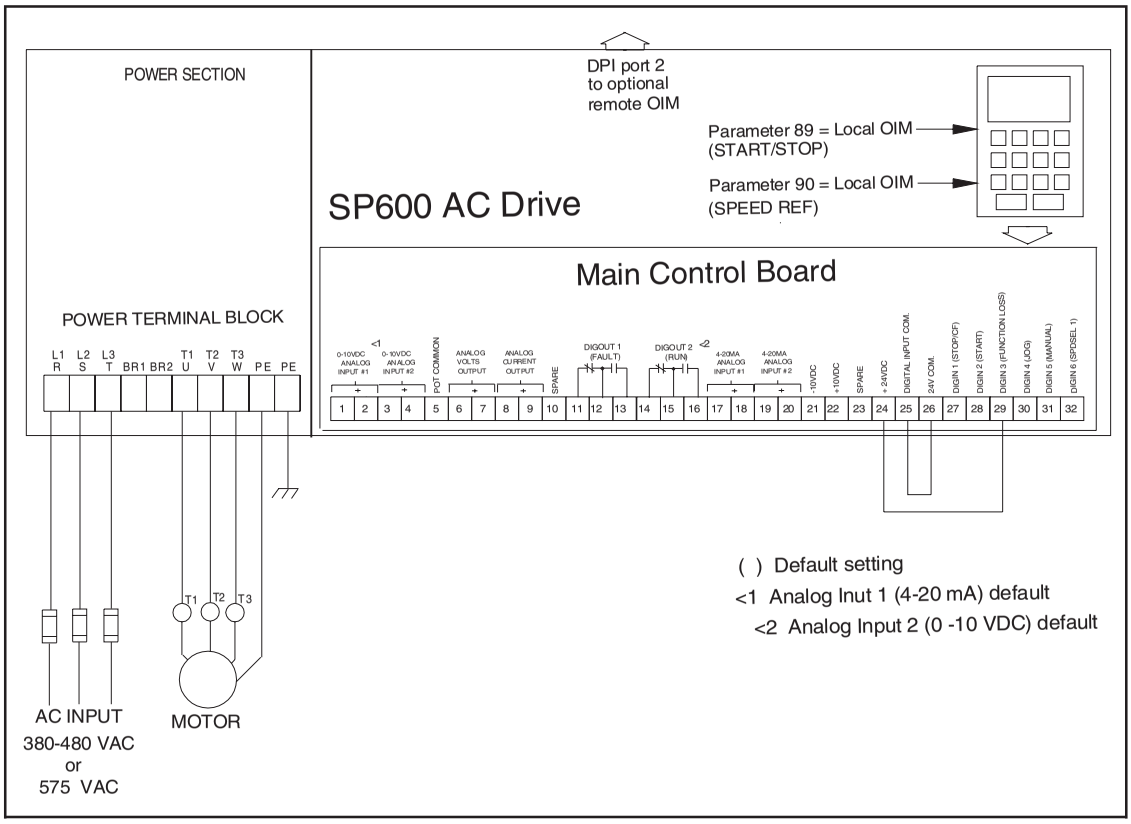


Figure 7.2 – Wiring Diagram - Default Drive Configuration

7.7 Speed Reference Control

The following sections describe methods of obtaining the drive speed reference.

7.7.1 Auto Reference Sources

The drive speed reference can be obtained from a number of different sources. The source is determined by drive programming and the condition of the Speed Select Digital Inputs or reference select bits of a drive command word.

The default source for a speed reference is the selection programmed in Speed Ref A Sel (parameter 90). If Speed Select digital inputs are defined on the terminal block, the drive could use other parameters as the speed reference source.

7.7.2 Manual Reference Sources

The manual reference source can be provided by:

- the terminal block
- an OIM connected to the local port
- remote OIM (port 2 or 3)
- the network port

Manual reference overrides any auto reference selected. By configuring the LCD OIM's function keys, an LCD OIM can provide a reference from preset speeds 1-7 or from DPI reference ports.

For a terminal block to select a manual source (TB Man Ref Sel (096)), one of its six digital inputs must be configured as "AUTO/MAN" and must be closed. (See figure 7.4)

See parameters Manual Mask (P286) and Manual Owner (P298) also.

7.7.3 Changing Reference Sources

The selection of the active Speed Reference can be made through digital inputs, DPI command, Jog key, or Auto/Manual OIM operation. See figures 7.3 and 7.4.

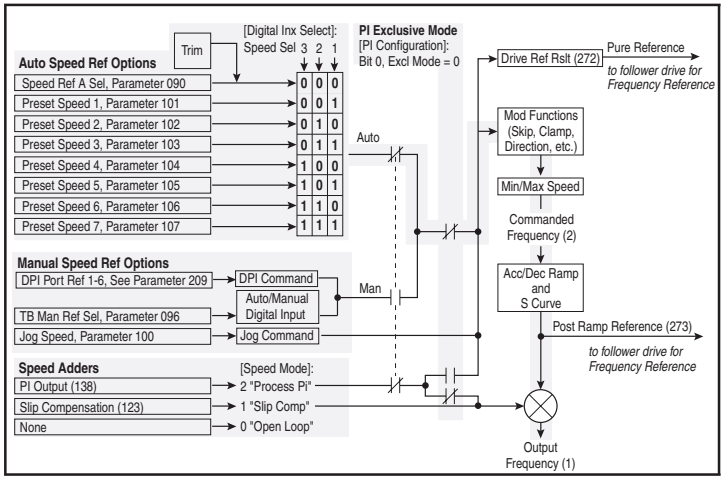


Figure 7.3 – Speed Reference Control Flowchart

7.7.4 Auto/Manual Control

The Auto/Manual input is not part of the logic commands controlled by parameter 89 (Logic Source Sel). The Auto/Manual input affects the speed reference source only.

In Auto reference mode, the reference source is determined by terminal block inputs (if configured) or a parameter (Speed Ref A Sel). Only one port at a time can control (own) the reference source.

In Manual reference mode, the reference source for the drive is based on the port that commanded it most recently. The last source that commands Manual reference mode will determine the reference used by the drive.

The Auto/Manual function is available through the terminal block (edge sensitive) and LCD OIM function keys. If configured on the terminal block, it is possible to have the digital input in the "Manual" position but have the Manual reference being controlled from another port. Because it is an edge-sensitive signal, the digital input would have to be switched to "Auto" and then back to "Manual" to re-acquire Manual reference control.

The Jog reference will bypass the Auto/Manual reference while it is asserted from the control source. When the Jog reference is released, the control source reverts to source that was in effect before the Jog reference was asserted.

When you select manual mode from the OIM “FNC Key” the speed setpoint (manual) is dictated by the OIM setpoints.

7.8 Remote OIM Configuration

If a remote OIM is connected as the user interface for speed reference or logic control, Logic Source Sel (89) and Speed Ref A Select (90) must be configured for the connection port to which the remote OIM is attached. Typically, a remote OIM is connected to port 2 or port 3.

Figure 7.4 – Speed Reference Selection

CHAPTER 8

Completing the Installation

This chapter provides instructions on how to perform a final check of the installation before power is applied to the drive.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should start and adjust it. Read and understand this manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

8.1 Checking the Installation

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: You must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation can result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

To verify the condition of the installation:

Step 1. Turn off, lock out, and tag the input power to the drive. Wait five minutes.

Step 2. Verify that the DC bus voltage is zero. See section 12.1.

Step 3. If a function loss coast-stop pushbutton has been installed, verify that it has been wired correctly.

Step 4. Remove any debris, such as metal shavings, from around the drive.

Step 5. Check that there is adequate clearance around the drive.

Step 6. Verify that there is nothing mounted behind the drive.

Step 7. Verify that the wiring to the terminal strip and the power terminals is correct.

Step 8. Check that the wire size is within terminal specification and that the terminals are tightened properly.

Step 9. Check that user-supplied branch circuit protection is installed and correctly rated.

Step 10. Check that the incoming power is rated correctly.

Step 11. Check the motor installation and length of motor leads.

Step 12. Disconnect any power correction capacitors connected between the drive and the motor.

Step 13. Check that the rating of the transformer (if used) matches the drive requirements and is connected properly.

Step 14. Verify that a properly-sized ground wire is installed and a suitable earth ground is used. Check for and eliminate any grounds between the motor frame and the motor power leads. Verify that all ground leads are unbroken.

Step 15. Uncouple the motor from any driven machinery.

8.2 Powering Up after Installation is Complete

To verify that the drive is installed correctly and is receiving the proper line voltage:

Step 1. Turn the drive's input power disconnect to the On position.

Step 2. Apply power to the drive.

Step 3. Follow the start-up procedure in chapter 9.

CHAPTER 9

Using the Start-Up Routines on the LCD OIM

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this chapter in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Incorrect values for some of the parameters in the Start-Up routines can cause the drive to operate improperly. Verify that the values of these parameters are appropriate for your application. Failure to observe this precaution could result in bodily injury.

For standard applications, the Start-Up routines on the LCD OIM enable you to configure the most commonly used parameters through a series of steps. This helps you set up the drive as quickly as possible.

For advanced applications, you may need to adjust additional parameters in the parameter list using either the LCD OIM or VS Utilities™ software.

9.1 Preparing for Start-Up

Before performing Start-Up, you must:

- be qualified to configure the drive and be familiar with the operation of AC drives.
- be familiar with the operation of the LCD OIM.
- have completed all hardware installation as described in chapters 3 through 8 of this manual.
- properly connect the drive to the motor.

9.2 Running the Start-Up Routines

To access the Start-Up routines, select the Start-Up icon from the main menu as shown in figure 9.1.

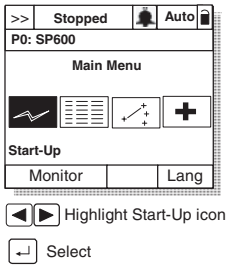


Figure 9.1 – Accessing the Start-Up Routines

The Start-Up menu screen contains 8 selections. The first 7 menu items contain the most commonly used parameters associated with each function. See figure 9.2.

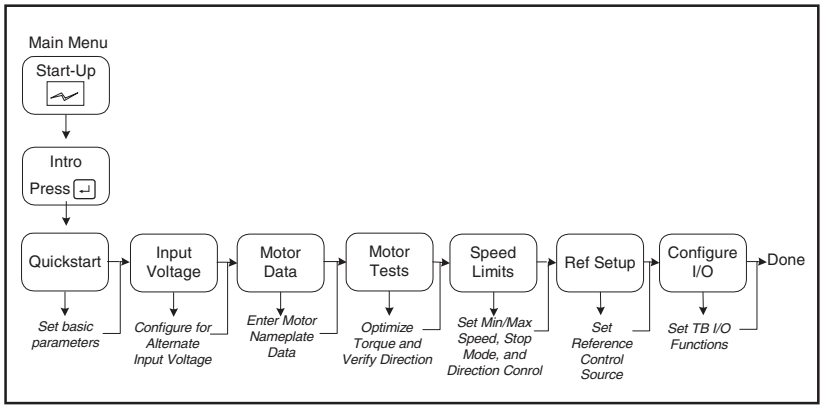


Figure 9.2 – Start-Up Menu

The Start-Up routine automates the process of entering values of selected parameters by taking you to the next parameter after you accept a parameter value. As each item in the list is completed, you are automatically advanced to the next step.

Important: Parameter values are saved as they are changed.

Pressing ESC/PROG or aborting the Start-Up routine will not undo the changes.

You do not have to configure all of the parameters in all 7 menus. The first menu selection, Quickstart, contains the minimum basic parameters that must be configured before running the drive. These parameters are listed in table 9.1.

The drive's default configuration assumes the following:

- US voltage class (202) = High voltage
- Motor nameplate base frequency (43) = 60 Hz
- Control mode (53) = Sensorless Vector
- Logic and Reference Source Select (89, 90) = Local OIM

Quickstart

Table 9.1 – Quickstart Parameters

Parameter No.	Parameter Name	Default
155	Stop Mode A	Ramp
42	Motor NP FLA	Drive-dependent
81	Minimum Speed	0.0 Hz
82	Maximum Speed	60.0 Hz
140	Accel Time 1	10.0 sec
142	Decel Time 1	10.0 sec
90	Speed Ref A Sel	OIM
362	Digital In2 Sel	Start

If your application requires adjustment to parameters beyond those listed in table 9.1, you can adjust the parameters in any or all of the next 6 selections in the Start-Up menu, or you can adjust parameters individually through the Parameters menu (see section 10.3).

Input Voltages

- 400/480 V
- 575 V

Motor Nameplate Data

- Motor Power Units
- Motor Power
- Motor FLA
- Motor Volts
- Motor Hertz
- Motor RPM

Motor Tests

- Direction
- Autotune

ATTENTION: Rotation of the motor in an undesired direction can occur during the Autotune procedure (Autotune (61) = Rotate Tune (2)). Disconnect the motor before proceeding. Failure to observe this precaution can result in damage to, or destruction of, the equipment.

Speed Limits

- Minimum, Maximum
- Direction Limit
- Stop Mode

Reference Setup

- OIM, Terminal Block, Network, Other

Configure I/O

- Digital Inputs/Outputs
- Two/Three Wire Start
- Analog Outputs

As you adjust the parameters in the Start-Up routines, record them in Appendix F.

When you have completed adjusting all of the parameters in the Start-Up routines that your application requires, select the last item in the menu, Done.

Exiting Before Completing the Start-Up Routines

To exit the Start-Up routines, press the F4 key (Exit). When you select the Start-Up icon from the main menu again, you will be prompted to either continue or restart the Start-Up routines. If you select “continue,” you will be returned to the point at which you exited.

9.2.1 Sensorless Vector Performance

If sensorless vector operation is required, Torque Performance (53) must be set to SVC operation. Autotune (61) must be reviewed to determine the appropriate method of autotuning.

9.2.2 High Speed Operation (>120 Hz)

The SP600 drive can operate at output frequencies of up to 400 Hz. In this case, autotuning may not be able to accurately tune the drive's current regulator. Hardware overcurrent faults may occur, and manual tuning using VS Utilities may be necessary. Consult technical support if this occurs.

9.3 Start/Stop Control

The default configuration is for keypad control. You can start and stop the drive from the local OIM.

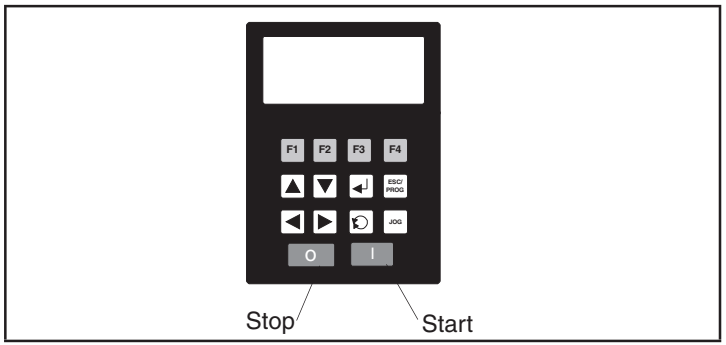


Figure 9.3 – Start/Stop Control using the Local OIM

To configure the drive for two-wire or three-wire Start/Stop control, you must set a terminal block input to either the Run function (2-wire) or Start function (3-wire). See section 7.5 for I/O wiring examples.

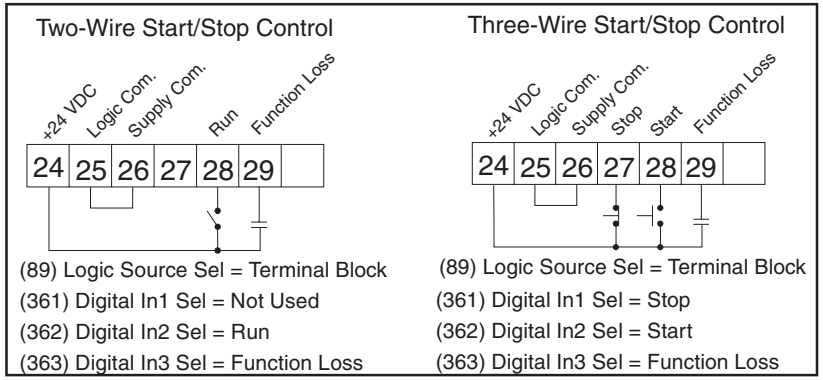


Figure 9.4 – Two-Wire and Three-Wire Start/Stop Control

9.4 Speed Reference

The default configuration is for keypad reference source. If you want to use an analog reference input for control, you must configure the analog reference inputs. The example below shows speed reference from an analog voltage input. Analog inputs can also be configured for 4 to 20 mA.

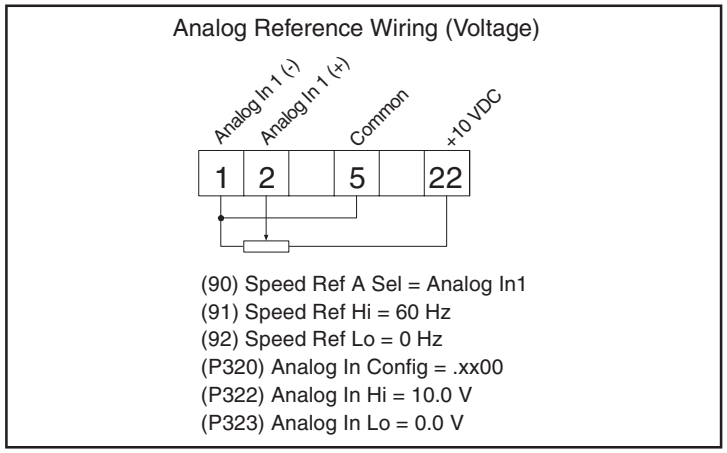


Figure 9.5 – Analog Speed Reference

9.5 Changing the Speed of the Drive (Setpoint Control)

OIM arrows only work to set speed changes when the LCD display is in the monitor mode.

If you select manual mode from the keypad (OIM) then the manual speed setpoint is set by the arrow keys.

CHAPTER 10

Programming Basics

To program the drive for a specific application, you adjust the appropriate parameters. The parameters are used to define characteristics of the drive.

This chapter provides an overview of parameter types and how they are organized. Parameter descriptions are provided in chapter 11.

10.1 About Parameters

There are three types of parameters:

- **Numbered List Parameters**
  Numbered list parameters allow a selection from two or more options. The LCD OIM displays a text message for each item.

  Example: Speed Ref A Sel (90)
- **Bit Parameters**
  Bit parameters have individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.

  Example: Drive Status 1 (209)
- **Numeric Parameters**
  These parameters have a single numerical value (for example, 0.1 volts).

  Example: Maximum Freq (55)

Parameters are also either configurable or tunable, or read-only.

Configurable parameters can be adjusted or changed only while the drive is stopped.

Tunable parameters can be adjusted or changed while the drive is running or stopped.

Read-only parameters cannot be adjusted.

10.2 How Parameters are Organized

Parameters are organized into seven files:

- Monitor
- Motor Control
- Speed Command
- Dynamic Control
- Utility
- Communication
- Inputs & Outputs

Each file contains parameters that are grouped by their function. A file can contain several groups of parameters. See figure 10.1.

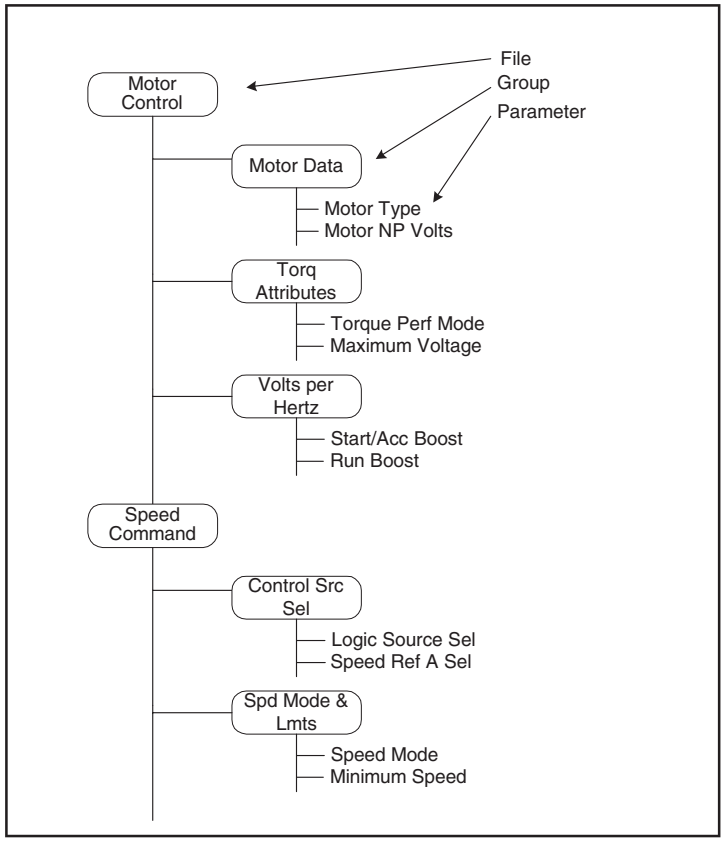


Figure 10.1 – Example of Parameter Organization

10.3 Accessing the Parameters

Parameters are programmed and viewed using the LCD OIM or VS Utilities software.

The LCD OIM displays parameters by group, by individual parameter number, and parameters that have changed from their default value.

To access parameters using the LCD OIM, select the Parameters icon from the main screen. See figure 10.2.

See Appendix B for information on modifying parameters using the LCD OIM.

See instruction manual D2-3488 for information on accessing and modifying parameters using VS Utilities software.

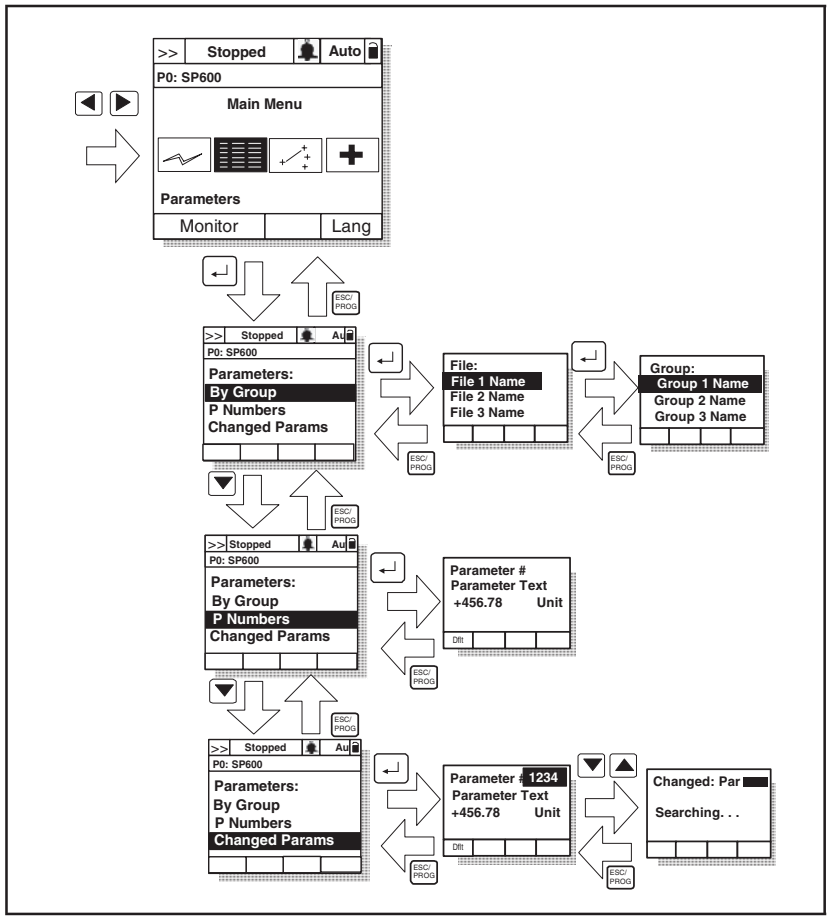


Figure 10.2 – Accessing the Parameters Using the LCD OIM

10.3.1 Selecting the Parameter Access Level

The SP600 AC drive provides three levels of access to the parameters: Basic (0), Standard (1), and Advanced (2).

The Advanced level allows access to all of the parameters.

The Standard level allows access to a subset of the Advanced level and is used for more sophisticated applications than the Basic level.

The Basic level allows access to a subset of the Standard level and contains only the most commonly used parameters.

The active access level is displayed in Parameter Access Level (196).

To select the parameter access level using the LCD OIM, select the Password icon from the main menu. See figure 10.3.

This option is not supported in the VS Utilities software.

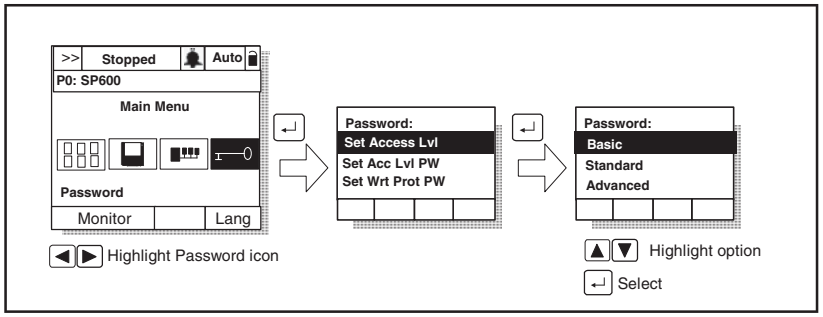


Figure 10.3 – Selecting the Parameter Access Level

10.3.2 Restricting Access to Other Parameter Levels

ATTENTION: It is the user's responsibility to determine how to distribute the access level password. Reliance Electric is not responsible for unauthorized access violations within the user's organization. Failure to observe this precaution could result in bodily injury.

The LCD OIM provides the option to restrict access to other parameter levels. This feature requires the use of a user-defined password when an attempt to change the access level is made.

To set the access level password, select the Password icon from the main menu. See figure 10.4. The password value can range from 1 to 9999. A value of 0 disables the password (factory default). You must either select Logout or return to the process display screen to activate the password.

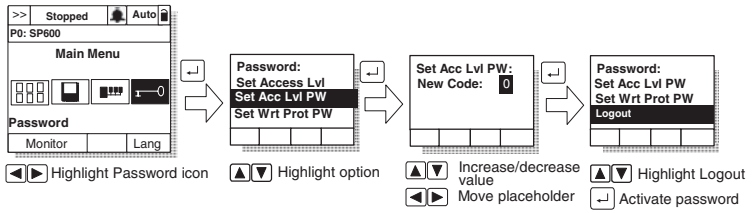


Figure 10.4 – Setting the Access Level Password

When you enter the password, you can change access levels until you select Logout or return to the process display screen, which re-activates the password. Refer to section B.8 in Appendix B for information about the process display screen.

Note that once the password is enabled, you will also be prompted to enter the password to access the Set Acc Lvl PW option.

This option is not supported in the VS Utilities software.

If There is More Than One OIM Connected to the Drive

Note that setting or changing the access level password on one OIM will set or change the access level password for all OIMs connected to the drive.

10.4 Ensuring Program Security

ATTENTION: It is the user's responsibility to determine how to distribute the write-protect password. Reliance Electric is not responsible for unauthorized access violations within the user's organization. Failure to observe this precaution could result in bodily injury.

Parameter values can be password-protected using the LCD OIM. When the password is enabled, parameter values can be displayed. However, if there is an attempt to change a parameter value, a password pop-up box will appear on the OIM screen to prompt for the user-defined password.

To set the write-protect password, select the Password icon from the main menu. See figure 10.5. The password value can range from 1 to 9999. A value of 0 disables the password (factory default).

When the password is enabled, the lock symbol on the screen changes from  to  .

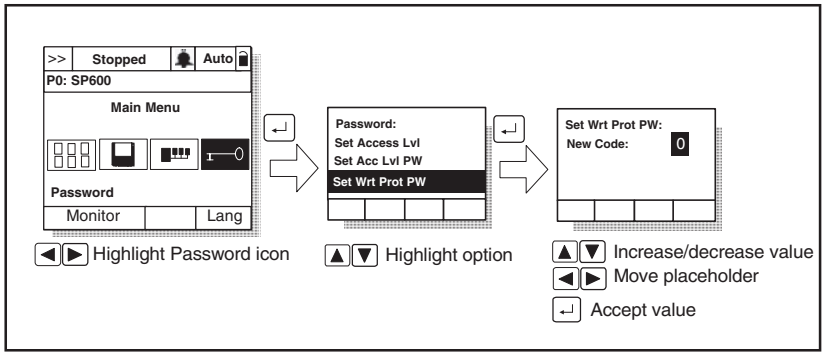


Figure 10.5 – Setting the Write-Protect Password

When you enter the password, you can adjust parameters until you select Logout or return to the process display screen, which re-activates the password. Refer to section B.8 in Appendix B for information about the process display screen.

This option is not supported in the VS Utilities software.

If There is More Than One OIM Connected to the Drive

Important: Setting the write-protect password value to zero on one OIM will disable the write-protect password on all connected OIMs.

Setting the write-protect password in one OIM will not affect any other OIM connected to the drive unless a write-protect password

has also been set in the other OIMs. In this case, the last password value entered becomes the password value for all password-protected OIMs. (Each OIM cannot have a different password value.)

For example, if the write-protect password has been set to 5555 for the local OIM, someone using a remote OIM with no write-protect password set can still program all of the parameters. If the write-protect password is then set to 6666 on the remote OIM, you will be required to enter 6666 on the local OIM to program the parameters.

CHAPTER 11

Parameter Descriptions

The following information is provided for each parameter along with its description:

Parameter Number:	Unique number assigned to each parameter.
Parameter Name:	Unique name assigned to each parameter.
Range:	Predefined parameter limits or selections. Note that a negative Hz value indicates reverse rotation.
Default:	Factory default setting.
Access:	Parameter access level. 0 = Basic (reduced parameter set) 1 = Standard (reduced parameter set) 2 = Advanced (full parameter set)
Path:	Menu selections to reach specified parameter. The path is indicated in this manner: File>Group
See also:	Associated parameters that may provide additional or related information.

What the Symbols Mean

Symbol	Meaning
	32-bit parameter
	Drive must be stopped before changing parameter value.

The parameters are presented in numerical order. Appendix C contains a list of parameters by name cross-referenced to parameter number.

Table 11.1 – Parameter List

No.	Parameter Name	Access Level	No.	Parameter Name	Acces s Level
1	Output Freq	0	63	Flux Current Ref	1
2	Commanded Freq	0	64	Ixo Voltage Drop	2
3	Output Current	0	69	Start/Acc Boost	2
4	Torque Current	1	70	Run Boost	2
5	Flux Current	1	71	Break Voltage	2
6	Output Voltage	0	72	Break Frequency	2
7	Output Power	0	80	Speed Mode	2
8	Output Power Fctr	2	81	Minimum Speed	0
9	Elapsed MWh	2	82	Maximum Speed	0
10	Elapsed Run Time	1	83	Overspeed Limit	2
11	MOP Frequency	1	84	Skip Frequency 1	2
12	DC Bus Voltage	1	85	Skip Frequency 2	2
13	DC Bus Memory	2	86	Skip Frequency 3	2
16	Analog In1 Value	1	87	Skip Freq Band	2
17	Analog In2 Value	1	89	Logic Source Sel	0
26	Rated kW	0	90	Speed Ref A Sel	0
27	Rated Volts	0	91	Speed Ref A Hi	1
28	Rated Amps	0	92	Speed Ref A Lo	1
29	Control SW Ver	0	96	TB Man Ref Sel	1
40	Motor Type	2	97	TB Man Ref Hi	1
41	Motor NP Volts	1	98	TB Man Ref Lo	1
42	Motor NP FLA	1	100	Jog Speed	0
43	Motor NP Hertz	1	101	Preset Speed 1	2
44	Motor NP RPM	1	102	Preset Speed 2	2
45	Motor NP Power	1	103	Preset Speed 3	2
46	Mtr NP Pwr Units	2	104	Preset Speed 4	2
47	Motor OL Hertz	2	105	Preset Speed 5	2
48	Motor OL Factor	2	106	Preset Speed 6	2
53	Torque Perf Mode	2	107	Preset Speed 7	2
54	Maximum Voltage	2	117	Trim In Select	2
55	Maximum Freq	2	118	Trim Out Select	2
56	Compensation	2	119	Trim Hi	2
57	Flux Up Mode	2	120	Trim Lo	2
58	Flux Up Time	2	121	Slip RPM @ FLA	2
59	SV Boost Filter	2	122	Slip Comp Gain	2
61	Autotune	0	123	Slip RPM Meter	2
62	IR Voltage Drop	1	124	PI Configuration	2

Table 11.1 – Parameter List

No.	Parameter Name	Access Level	No.	Parameter Name	Acces s Level
125	PI Control	2	170	Flying StartGain	2
126	PI Reference Sel	2	174	Auto Rstrt Tries	1
127	PI Setpoint	2	175	Auto Rstrt Delay	1
128	PI Feedback Sel	2	178	Sleep-Wake Mode	2
129	PI Integral Time	2	179	Sleep-Wake Ref	2
130	PI Prop Gain	2	180	Wake Level	2
131	PI Lower Limit	2	181	Wake Time	2
132	PI Upper Limit	2	182	Sleep Level	2
133	PI Preload	2	183	Sleep Time	2
134	PI Status	2	184	Power Loss Mode	1
135	PI Ref Meter	2	185	Power Loss Time	1
136	PI Fdback Meter	2	186	Power Loss Level	2
137	PI Error Meter	2	190	Direction Mode	0
138	PI Output Meter	2	192	Save OIM Ref	2
140	Accel Time 1	0	193	Man Ref Preload	2
141	Accel Time 2	2	194	Save MOP Ref	2
142	Decel Time 1	0	195	MOP Rate	2
143	Decel Time 2	2	196	Param Access Lvl	0
146	S Curve %	0	197	Reset To Defalts	0
147	Current Lmt Sel	2	198	Load Frm Usr Set	1
148	Current Lmt Val	0	199	Save To User Set	1
149	Current Lmt Gain	2	200	Reset Meters	1
150	Drive OL Mode	1	201	Language	2
151	CarrierFrequency	0	202	Voltage Class	2
155	Stop Mode A	1	203	Drive Checksum	2
156	Stop Mode B	1	204	Dyn UserSet Cnfg	2
157	DC Brake Lvl Sel	1	205	Dyn UserSet Sel	2
158	DC Brake Level	1	206	Dyn UserSet Actv	2
159	DC Brake Time	1	209	Drive Status 1	2
160	Bus Reg Gain	2	210	Drive Status 2	2
161	Bus Reg Mode A	2	211	Drive Alarm 1	1
162	Bus Reg Mode B	2	212	Drive Alarm 2	1
163	DB Resistor Type	1	213	Speed Ref Source	2
164	Bus Reg Kp	2	214	Start Inhibits	2
165	Bus Reg Kd	2	215	Last Stop Source	2
168	LevelSense Start	2	216	Dig In Status	2
169	Flying Start En	2	217	Dig Out Status	2

Table 11.1 – Parameter List

No.	Parameter Name	Access Level	No.	Parameter Name	Acces s Level
218	Drive Temp	2	311	Data Out A2 - Link A Word 2	2
219	Drive OL Count	2	312	Data Out B1 - Link B Word 1	2
220	Motor OL Count	2	313	Data Out B2 - Link B Word 2	2
224	Fault Frequency	2	314	Data Out C1 - Link C Word 1	2
225	Fault Amps	2	315	Data Out C2 - Link C Word 2	2
226	Fault Bus Volts	2	316	Data Out D1 - Link D Word 1	2
227	Status 1 @Fault	2	317	Data Out D2 - Link D Word 2	2
228	Status 2 @ Fault	2	320	Anlg In Config	0
229	Alarm 1 @Fault	1	321	Anlg In Sqr Root	2
230	Alarm 2 @ Fault	1	322	Analog In 1 Hi	0
234	Testpoint 1 Sel	2	323	Analog In 1 Lo	0
235	Testpoint 1 Data	2	324	Analog In 1 Loss	2
236	Testpoint 2 Sel	2	325	Analog In 2 Hi	2
237	Testpoint 2 Data	2	326	Analog In 2 Lo	2
238	Fault Config 1	2	327	Analog In 2 Loss	2
240	Fault Clear	2	340	Anlg Out Config	1
241	Fault Clear Mode	2	341	Anlg Out Absolut	2
242	Power Up Marker	2	342	Analog Out1 Sel	1
259	Alarm Config 1	2	343	Analog Out1 Hi	1
271	Drive Logic Rslt	2	344	Analog Out1 Lo	1
272	Drive Ref Result	2	361	Digital In1 Sel	1
273	Drive Ramp Result	2	362	Digital In2 Sel	1
286	Manual Mask	2	363	Digital In3 Sel	1
288	Stop Owner	2	364	Digital In4 Sel	1
298	Manual Owner	2	365	Digital In5 Sel	1
300	Data In A1 - Link A Word 1	2	366	Digital In6 Sel	1
301	Data In A2 - Link A Word 2	2	380	Digital Out1 Sel	1
302	Data In B1 - Link B Word 1	2	381	Dig Out1 Level	1
303	Data In B2 - Link B Word 2	2	382	Dig Out1 OnTime	2
304	Data In C1 - Link C Word 1	2	383	Dig Out1 OffTime	2
305	Data In C2 - Link C Word 2	2	384	Digital Out2 Sel	1
306	Data In D1 - Link D Word 1	2	385	Dig Out2 Level	1
307	Data In D2 - Link D Word 2	2	386	Dig Out2 OnTime	2
310	Data Out A1 - Link A Word 1	2	387	Dig Out2 OffTime	2

1 Output Freq

Range: +/-400.0 Hz [0.1 Hz]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

The output frequency present at T1, T2, and T3 (U, V, and W). This value includes reference, slip comp, and IR compensation.

2 Commanded Freq

Range: +/- 400.0 Hz [0.1 Hz]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

The value of the active pre-ramp reference frequency command.

3 Output Current

Range: 0.0 to Drive Rated Amps x 2 [0.1 Amps]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

The total output current present at T1, T2, and T3 (U, V, and W), which includes torque and flux components.

4 Torque Current

Range: Drive Rating x -2 to +2 [0.1 Amps]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

The amount of current that is in phase with the fundamental voltage component. This is the torque-producing component of the output current.

5 Flux Current

Range: Drive Rating x -2 to +2 [0.1 Amps]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

The amount of current that is out of phase with the fundamental voltage component. This is the magnetizing component of the output current.

6 Output Voltage

Range: 0.0 to Drive Rated Volts [0.1 VAC]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

The output voltage present at T1, T2, and T3 (U, V, and W).

7 Output Power

Range: 0.0 to Drive Rated kW x 2 [0.1 kW]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

The output power present at T1, T2, and T3 (U, V, and W).

8 Output Powr Fctr

Range: 0.00 to 1.00 [0.01]
Default: Read Only
Access: 2 **Path:** Monitor>Metering
See also:

The output power factor.

9 Elapsed MWh

Range: 0.0 to 429,496,729.5 MWh [0.1 MWh]
Default: Read Only
Access: 2 **Path:** Monitor>Metering
See also:

The accumulated output energy of the drive.

10 Elapsed Run Time

32

Range: 0.0 to 429,496,729.5 Hr [0.1 Hr]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also: 194,195

The accumulated time the drive has been outputting power.

11 MOP Frequency

Range: +/- 400.0 [0.1 Hz]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

The setpoint value of the MOP (Motor-Operated Potentiometer) function.

12 DC Bus Voltage

Range: 0.0 to Based on Drive Rating[1] [0.1 VDC]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

[1]200% of bus voltage limit.

The present DC bus voltage level.

13 DC Bus Memory

Range: 0.0 to Based on Drive Rating[1] [0.1 VDC]
Default: Read Only
Access: 2 **Path:** Monitor>Metering
See also:

[1]200% of bus voltage limit.

A six-minute average of the DC bus voltage level.

16 Analog In1 Value
17 Analog In2 Value

Range: 4.000 to 20.000 mA [0.001 mA]
-/+10.0 V [0.1 V]

Default: Read Only

Access: 16=1 **Path:** Monitor>Metering
17=1

See also: 320

The value of the signal at the analog inputs. This value does not include scaling information programmed by the user (for example, Analog In1 Hi). The terminals monitored depend on the setting of Anlg In Config (320). The inputs can be configured as voltage or current.

26 Rated kW

Range: 0.37 to 87.0 kW [0.1 kW]

Default: Read Only

Access: 0 **Path:** Monitor>Drive Data

See also:

The drive power rating.

27 Rated Volts

Range: 208 to 600 V [0.1 VAC]

Default: Read Only

Access: 0 **Path:** Monitor>Drive Data

See also:

The drive input voltage class (208, 240, 400, etc.).

28 Rated Amps

Range: 1.1 to 125.0 Amps [0.1 Amps]

Default: Read Only

Access: 0 **Path:** Monitor>Drive Data

See also:

The drive rated output current.

29 Control SW Ver

Range: 0.000 to 65.256 [0.001]
Default: Read Only
Access: 0 **Path:** Monitor>Drive Data
See also: 196

The Main Control board software version.

Important: Selecting option 1 or 2 also requires selection of "Custom V/Hz," option 2 in Torque Perf Mode (53).

40 Motor Type

Range: 0 = Induction
1 = Synchr Reluc
2 = Synchr PM
Default: 0 = Induction
Access: 2 **Path:** Motor Control>Motor Data
See also:

Set to match the type of motor connected.

41 Motor NP Volts

Range: 0.0 to Drive Rated Volts [0.1 VAC]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also:

Set to the motor nameplate rated volts. The motor nameplate base voltage defines the output voltage when operating at rated current, rated speed, and rated temperature.

42 Motor NP FLA

Range: 0.0 to Rated Amps x 2 [0.1 Amps]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also: 47, 48

Set to the motor nameplate rated full load amps. The motor nameplate FLA defines the output amps when operating at rated voltage, rated speed, and rated temperature. It is used in the motor thermal overload and in the calculation of slip.

Since the motor thermal overload cannot distinguish individual currents in a multimotor application, it is suggested that it be disabled in these cases. This can be done by setting the correct bit in Fault Config (238) to zero to disable the motor thermal overload.

The operation of the overload is actually based on three parameters: 1) Motor NP FLA (42), 2) Motor OL Factor (48), and 3) Motor OL Hertz (47). The motor nameplate full load amps is then multiplied by the motor overload factor to allow you to re-define the continuous level of current allowed by the motor thermal overload.

43 Motor NP Hertz

Range: 5.0 to 400.0 Hz [0.1 Hz]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also:

Set to the motor nameplate rated frequency. The motor nameplate base frequency defines the output frequency when operating at rated voltage, rated current, rated speed, and rated temperature.

44 Motor NP RPM

Range: 60 to 24000 RPM [1 RPM]
Default: 1750 RPM
Access: 1 **Path:** Motor Control>Motor Data
See also:

Set to the motor nameplate rated RPM. The motor nameplate RPM defines the rated speed when operating at motor nameplate base frequency, rated current, base voltage, and rated temperature. This is used to calculate slip.

45 Motor NP Power

Range: 0.00 to 5000.00 [0.01]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also: 46

Set to the motor nameplate rated power. The motor nameplate power is used with the other nameplate values to calculate default values for motor parameters to assist the commissioning process. This may be entered in horsepower or in kilowatts as selected in parameter 46.

46 Mtr NP Pwr Units

Range: 0 = Horsepower
1 = kiloWatts

Default: Based on Drive Type

Access: 2 **Path:** Motor Control>Motor Data

See also:

Set to the power units shown on the motor nameplate. This parameter determines the units for parameter 45.

47 Motor OL Hertz

Range: 0.0 to 400.0 Hz [0.1 Hz]

Default: Motor NP Hz / 3

Access: 2 **Path:** Motor Control>Motor Data

See also: 42, 220

Motor Overload Hz is used to allow you to adjust the response of the motor thermal overload to lower motor speeds (lower output frequencies) where a higher degree of protection may be required due to decreased motor cooling.

This parameter selects the output frequency below which the motor operating current is derated. The motor thermal overload could generate a fault at below rated current. For all settings of overload Hz other than zero, the overload capacity is reduced to 70% when output frequency is zero.

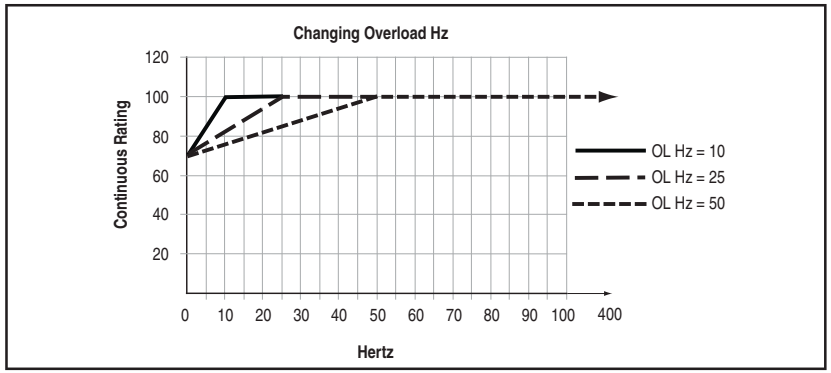


Figure 11.1 – Motor Overload Hertz

48 Motor OL Factor

Range: 0.20 to 2.00 [0.01]
Default: 1.00
Access: 2 **Path:** Motor Control>Motor Data
See also: 42, 220

Sets the continuous current operating level for the motor.

This parameter can be used to raise the level of current that will cause the motor thermal overload to trip. The effective overload factor is a combination of parameters 47 and 48.

Motor FLA x OL Factor = Operating Level (continuous)

53 Torque Perf Mode

Range: 0 = Sensrls Vect
1 = SV Economize
2 = Custom V/Hz
3 = Fan/Pmp V/Hz
Default: 0 = Sensrls Vect
Access: 2 **Path:** Motor Control>Torq Attributes
See also: 62, 63, 69, 70

Sets the method of motor torque production.

- Sensrls Vect maintains consistent magnetizing current up to base speed, and voltage increases as a function of load.
- SV Economize allows the drive to automatically adjust output voltage as the load changes to minimize current supplied to the motor. The voltage is adjusted by means of flux current adaption.
- Custom V/Hz allows for tailoring the volts/hertz curve by adjusting parameters 54, 55, 70, 71 and 72.

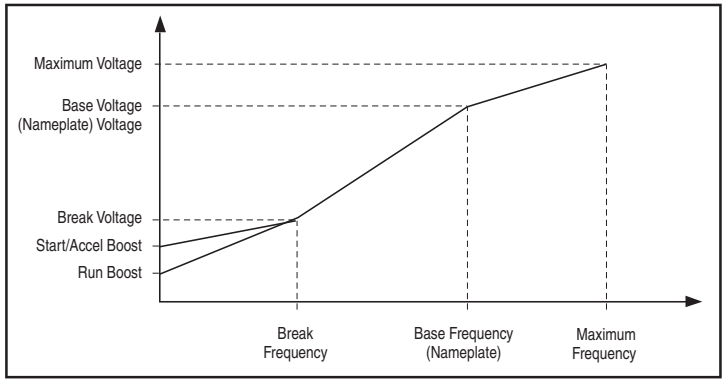


Figure 11.2 – Custom V/Hz Curve

- Fan/Pmp V/Hz mode sets a fan load volts per hertz curve profile exponential to base frequency and linear from base to maximum frequency). Run boost can offset the low speed curve point.

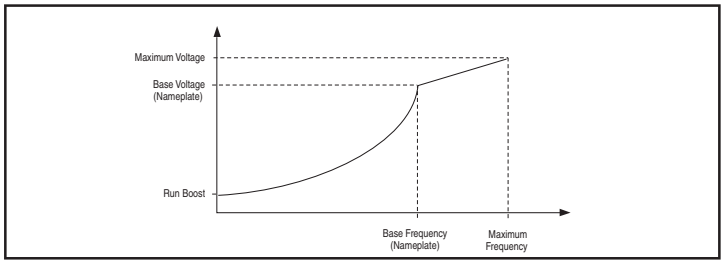


Figure 11.3 – Fan/Pump Curve

54 Maximum Voltage

Range: (Rated Volts x 0.25) to Rated Volts [0.1 VAC]
Default: Drive Rated Volts
Access: 2 **Path:** Motor Control>Torq Attributes
See also:

Sets the highest voltage the drive will output

55 Maximum Freq

Range: 5.0 to 400.0 Hz [0.1 Hz]
Default: 130.0 Hz
Access: 2 **Path:** Motor Control>Torq Attributes
See also: 82, 83

Sets the maximum allowable frequency the drive will output. Note that this is not maximum speed, which is set in parameter 82. Refer to figure 11.4.Maximum Speed (82) + Overspeed Limit (83) must be ≤ to Maximum Freq (55).

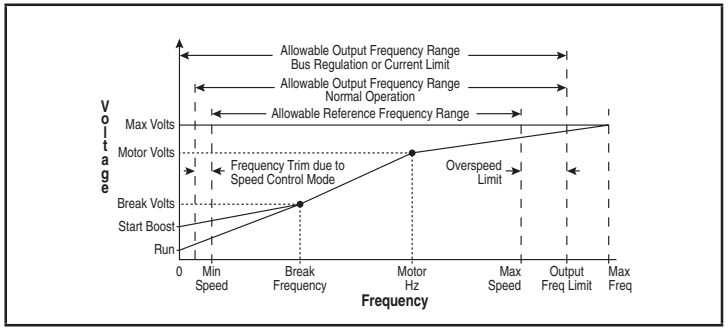


Figure 11.4 – Speed Limits

56 Compensation

Range:	See figure 11.5		
Default:	See figure 11.5		
Access:	2	**Path:**	Motor Control>Torq Attributes
See also:			

Enables/disables the compensation correction options.

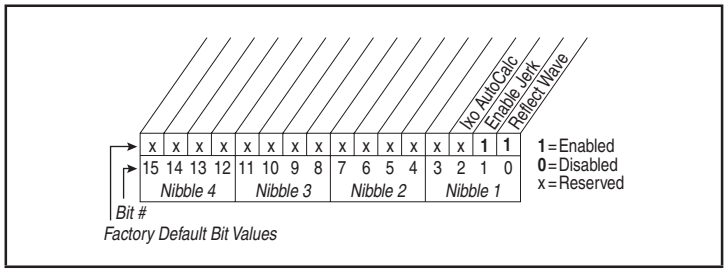


Figure 11.5 – Compensation (56)

Bit 0 - Reflect Wave

- Enables/disables reflected wave correction software, which reduces overvoltage transients from the drive to the motor. For lead lengths beyond 300 feet, enable this feature.

Bit 1 - Enable Jerk

- Enables/disables the jerk limit in the current limiter that helps to eliminate overcurrent trips on fast accelerations. Disable this feature if your application requires the actual acceleration of the motor to be faster than .25 sec.

Bit 2 - Ixo AutoCalc

- Calculates voltage drop due to leakage inductance (see parameter 64).

57 Flux Up Mode

Range: 0 = Manual
1 = Automatic

Default: 0 = Manual

Access: 2 **Path:** Motor Control>Torq Attributes

See also: 53, 58

Flux-up current is the amount of DC current equal to current limit, so full flux can be established in the motor before acceleration.

Manual (0): Flux is established for Flux Up Time (58) before acceleration

Auto (1): Flux is established for a calculated time period based on motor nameplate data. Flux Up Time (58) is not used.

58 Flux Up Time

Range: 0.00 to 5.00 Sec [0.01 Sec]

Default: 0.0 Sec

Access: 2 **Path:** Motor Control>Torq Attributes

See also: 53, 58

Sets the amount of time the drive will use to try to achieve full motor stator flux. When a start command is issued, DC current at current limit level is used to build stator flux before accelerating.

59 SV Boost Filter

Range: 0 to 32767

Default: 500

Access: 2 **Path:** Motor Control>Torq Attributes

See also:

Sets the amount of filtering used to boost voltage during Sensorless Vector operation.

61 Autotune

Range:	0 = Ready 1 = Static Tune 2 = Rotate Tune 3 = Calculate
Default:	3 = Calculate
Access:	0 **Path:** Motor Control>Torq Attributes
See also:	53, 62, 63

Provides a manual or automatic method for setting IR Voltage Drop (62) and Flux Current Ref (63). These values affect sensorless vector performance. Valid only when Torque Perf Mode (53) is set to Sensrls Vect or SV Economize.

Ready (0) = Parameter returns to this setting following a Static Tune or Rotate Tune. It also permits manually setting IR Voltage Drop (62) and Flux Current Ref (63).

Static Tune (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of IR Voltage Drop. A start command is required following the initiation of this setting. The parameter returns to Ready (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when the motor cannot be uncoupled from the load.

Rotate Tune (2) = A temporary command that initiates a Static Tune followed by a rotational test for the best possible automatic setting of Flux Current Ref. A start command is required following initiation of this setting. The parameter returns to Ready (0) following the test, at which time another start transition is required to operate the drive in normal mode.

ATTENTION: Rotation of the motor in an undesired direction can occur during this procedure (Autotune (61) = Rotate Tune (2)). To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding.

Important: Rotate Tune (2) is used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure.

Calculate (3) = This setting uses motor nameplate data to automatically set IR Voltage Drop and Flux Current Ref.

62 IR Voltage Drop

Range: 0.0 to Motor NP Volts x 0.25 [0.1 VAC]
Default: Motor NP Volts x 0.25
Access: 1 **Path:** Motor Control>Torq Attributes
See also: 53

Value of volts dropped across the resistance of the motor stator. Used only when Torque Perf Mode (53) is set to Sensrls Vect or SV Economize. This value can be set by the Autotune procedure.

63 Flux Current Ref

Range: 0.00 to Motor NP FLA [0.01 Amps]
Default: Based on Drive Rating
Access: 1 **Path:** Motor Control>Torq Attributes
See also: 53

Value of amps for full motor flux. Used only when Torque Perf Mode (53) is set to Sensrls Vect or SV Economize. This value can be set by the Autotune procedure.

64 Ixo Voltage Drop

Range: 0.0 to Motor NP Volts [0.1 VAC]
Default: Based on Drive Rating
Access: 2 **Path:** Motor Control>Torq Attributes
See also:

Sets the value of the voltage drop due to leakage inductance of the motor. Used only when Torque Perf Mode (53) is set to Sensrls Vect or SV Economize.

69 Start/Acc Boost

Range: 0.0 to Motor NP Volts x 0.25 [0.1 VAC]
Default: Motor NP Volts x 0.25
Access: 2 **Path:** Motor Control>Volts per Hertz
See also: 53, 70, 83

Sets the voltage boost level for starting and acceleration when Custom V/Hz mode is selected in Torque Perf Mode (53).

After acceleration has stopped, the output volts per hertz is set by the steady state operating curve.

70 Run Boost

Range:	0.0 to Motor NP Volts x 0.25 [0.1 VAC]
Default:	Motor HP Volts x 0.25
Access:	2 **Path:** Motor Control>Volts per Hertz
See also:	53, 69, 83

Sets the boost level for steady state or deceleration when Fan/Pmp V/Hz or Custom V/Hz modes are selected in Torque Perf Mode (53).

This boost level applies in the range from zero to break frequency (Hz).

71 Break Voltage

Range:	0.0 to Motor NP Volts [0.1 VAC]
Default:	Motor NP Volts x 0.25
Access:	2 **Path:** Motor Control>Volts per Hertz
See also:	53, 72, 83

Sets the voltage the drive will output at Break Frequency (72).

Defines the volts per hertz ratio at break frequency. Applies only in Fan/Pmp V/Hz or Custom V/Hz modes.

72 Break Frequency

Range:	0.0 to 400.0 [0.1 Hz]
Default:	Motor NP Freq x 0.25
Access:	2 **Path:** Motor Control>Volts per Hertz
See also:	53, 71, 83

Sets the frequency at which Run Boost volts per hertz adaption ends. Applies only in Fan/Pmp V/Hz or Custom V/Hz modes.

80 Speed Mode

Range:	0 = Open Loop 1 = Slip Comp 2 = Process PI
Default:	0 = Open Loop
Access:	2 **Path:** Speed Command>Spd Mode & Limits
See also:	124 -138

Sets the method of speed regulation.

- Open Loop provides no speed compensation due to load variations. This is strict volts per hertz output as a function of the speed reference.

- Slip Comp provides for frequency output adjustment as a function of load. The amount of compensation is defined by the value of Slip RPM @ FLA.
- Process PI allows for the output motor speed (frequency) to be adjusted based on the outer control loop regulator.

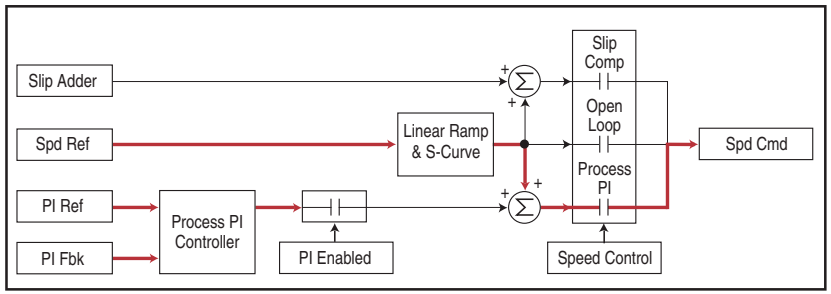


Figure 11.6 – Speed Control Method

81 Minimum Speed

Range: 0.0 to Maximum Speed [0.1 Hz]

Default: 0.0 Hz

Access: 0 **Path:** Speed Command>Spd Mode & Limits

See also: 83, 92, 95

Sets the low limit for the speed reference after scaling is applied.

ATTENTION: The drive can operate at and maintain zero speed. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audible or visual alarms, or other devices to indicate that the drive is operating or may operate at or near zero speed. Failure to observe this precaution could result in severe bodily injury or loss of life.

82 Maximum Speed

Range: 5.0 to 400.0 Hz [0.0 Hz]
Default: 50.0 or 60.0 Hz (dependent on voltage class)
Access: 0 **Path:** Speed Command>Spd Mode & Limits
See also: 55, 83, 91, 94, 202

Sets the high limit for the speed reference after scaling is applied.

Maximum Speed (82) + Overspeed Limit (83) must be ≤ to Maximum Freq (55).

ATTENTION: The user is responsible for ensuring that driven machinery, all drive-train mechanisms, and application material are capable of safe operation at the maximum operating speed of the drive. Overspeed detection in the drive determines when the drive shuts down. See figure 11.7**.** Failure to observe this precaution could result in bodily injury.

83 Overspeed Limit

Range: 0.0 to 20.0 Hz [0.1 Hz]
Default: 10.0 Hz
Access: 2 **Path:** Speed Command>Spd Mode & Limits
See also: 55, 82

Sets the incremental amount of the output frequency (above Maximum Speed) allowable for functions such as slip compensation. See figure 11.7.

Maximum Speed (82) + Overspeed Limit (83) must be ≤ to Maximum Freq (55).

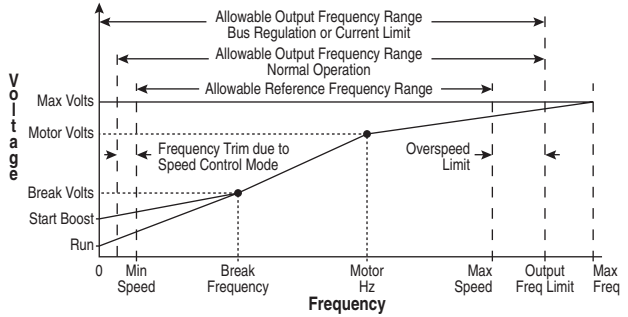


Figure 11.7 – Speed Limits

84 Skip Frequency 1
85 Skip Frequency 2
86 Skip Frequency 3

Range: -/+400.0 [0.1 Hz]

Default: 0.0 Hz

Access: 84=2 **Path:** Speed Command>Spd Mode & Limits
85=2
86=2

See also: 87

Sets the center of a frequency band at which the drive will not operate continuously (also called an **avoidance frequency**). Requires that both a Skip Frequency and Skip Frequency Band (87) be set to a value other than 0.

87 Skip Freq Band

Range: 0.0 to 30.0 Hz [0.1 Hz]

Default: 0.0 Hz

Access: 2 **Path:** Speed Command>Spd Mode & Limits

See also: 84, 85, 86

Determines the bandwidth around a skip frequency (half the band above and half the band below the skip frequency).

89 Logic Source Sel

Range: 0 = Terminal Blk
1 = Local OIM
2 = DPI Port 2
3 = DPI Port 3
4 = Reserved
5 = Network
6 = Reserved
7 = All Ports

Default: 1 = Local OIM

Access: 0 **Path:** Speed Command>Control Src Select

See also: 90

Important: The drive is shipped with a default configuration of control from the Local OIM (keypad). For drive control from the terminal block inputs, Logic Source Sel (89), must be set to 0.

- Terminal Blk = Hardwired I/O
- Local OIM = Drive-mounted OIM
- DPI Port 2 = DIN connector DPI port
- DPI Port 3 = DIN port 2 split with option cable
- Network = Communication interface
- All Ports = All control sources active

ATTENTION: Changing parameter 89 to Terminal Blk or Network while LevelSense Start is enabled may start the drive if a start command is on from the newly selected logic source.

When LevelSense Start is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Logic Source Sel (89) selects the control source for the following logic commands:

- Start
- Clear Faults
- Stop
- Jog
- Direction
- Run

The All Ports selection allows all ports to control the logic command simultaneously.

ATTENTION: Note the following about stop commands:

- A stop command from any attached OIM will always be enabled regardless of the value of Logic Source Sel.
- Network stop commands are effective only when Logic Source Sel is set to Network or All Ports.
- Terminal block stop commands are effective only when Logic Source Sel is set to Terminal Blk or All Ports.

Failure to observe these precautions could result in severe bodily injury or loss of life.

Important: Asserting the terminal block input assigned to OIM control will override parameter 89.

90 Speed Ref A Sel

Range:	1 = Analog In 1 2 = Analog In 2 3-8 = Reserved 9 = MOP Level 10 = Reserved 11 = Preset Spd 1 12 = Preset Spd 2 13 = Preset Spd 3 14 = Preset Spd 4 15 = Preset Spd 5 16 = Preset Spd 6 17 = Preset Spd 7 18 = Local OIM 19 = DPI Port 2 20 = DPI Port 3 21 = Reserved 22 = Network 23 = Reserved
Default:	18 = Local OIM
Access:	0 **Path:** Speed Command>Speed References Speed Command>Control Src Select
See also:	2, 91-92, 101-107, 117-120, 192-194, 213, 272, 273, 320-327, 361-366

Selects the source of the speed reference to the drive unless Preset Speed 1-7 (101-107) is selected.

Note that the manual reference command and inputs OIM Control can override the reference control source.

ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

91 Speed Ref A Hi

Range: -/+ Maximum Speed [0.1 Hz]

Default: Maximum Speed

Access: 1 **Path:** Speed Command>Speed References

See also: 82, 322, 324

Scales the upper value of the Speed Ref Sel (90) selection when the source is an analog input. This value corresponds to the value entered in parameter 322 or 324.

92 Speed Ref A Lo

Range: -/+ Maximum Speed [0.1 Hz]

Default: 0.0 Hz

Access: 1 **Path:** Speed Command>Speed References

See also: 81, 323, 325

Scales the lower value of the Speed Ref A Sel (90) selection when the source is an analog input. This value corresponds to the value entered in parameter 323 or 325.

96 TB Man Ref Sel

Range: 1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level

Default: 2 = Analog In 2

Access: 1 **Path:** Speed Command>Speed References

See also: 97, 98

Specifies the manual speed reference source when a digital input is configured for manual selection. See parameters 361 to 366.

97 TB Man Ref Hi

Range: -/+Maximum Speed [0.1 Hz]

Default: Maximum Speed

Access: 1 **Path:** Speed Command>Speed References

See also: 96, 322, 324

Scales the upper value of the TB Man Ref Sel selection when the source is an analog input. This parameter should be set in conjunction with parameter 322 or 325, depending on the analog input being used.

98 TB Man Ref Lo

Range: -/+Maximum Speed [0.1 Hz]
Default: 0.0 Hz
Access: 1 Path: Speed Command>Speed References
See also: 96, 323, 325

Scales the lower value of the TB Man Ref Sel selection when the source is an analog input. This parameter should be set in conjunction with parameter 323 or 326, depending on the analog input being used.

100 Jog Speed

Range: 0 to Maximum Speed [0.1 Hz]
Default: 10.0 Hz
Access: 0 Path: Speed Command>Discrete Speeds
See also:

Sets the output frequency when a jog command is issued. The jog function can be activated using the OIM or terminal block assignments.

101 Preset Speed 1
102 Preset Speed 2
103 Preset Speed 3
104 Preset Speed 4
105 Preset Speed 5
106 Preset Speed 6
107 Preset Speed 7

Range: -/+ Maximum Speed [0.1 Hz]
Default: See table 11.2
Access: 2 **Path:** Speed Command>Discrete Speeds
See also: 90, 93

Provides an internal fixed speed command value when Speed Ref A = Preset Spd 1-7. The preset speed is selected by the configuration of the Dig In # speed select functions.

Table 11.2 – Default Values for Preset Speeds 1-7

Parameter No.	Parameter Name	Default
101	Preset Speed 1	5.0 Hz
102	Preset Speed 2	10.0 Hz
103	Preset Speed 3	20.0 Hz
104	Preset Speed 4	30.0 Hz
105	Preset Speed 5	40.0 Hz
106	Preset Speed 6	50.0 Hz
107	Preset Speed 7	60.0 Hz

117 Trim In Select

Range:	1 = Analog In 1 2 = Analog In 2 3-8 = Reserved 9 = MOP Level 10 = Reserved 11 = Preset Spd 1 12 = Preset Spd 2 13 = Preset Spd 3 14 = Preset Spd 4 15 = Preset Spd 5 16 = Preset Spd 6 17 = Preset Spd 7 18 = Local OIM 19 = DPI Port 2 20 = DPI Port 3 21 = Reserved 22 = Network 23 = Reserved
Default:	2 = Analog In 2
Access:	2 **Path:** Speed Command>Speed Trim
See also:	90, 93

Specifies which signal source is being used as a trim input. The trim is an input signal which is added to the reference A signal. If an analog input is used as the trim signal, two scaling parameters are provided.

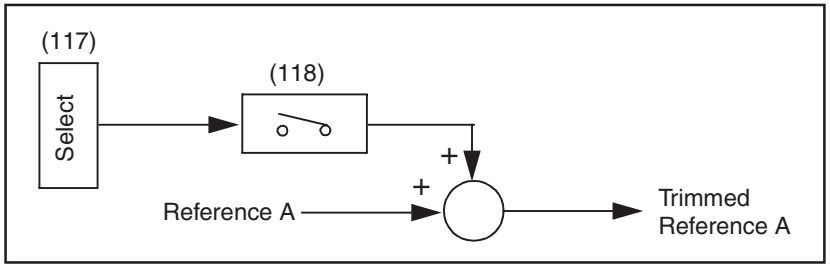


Figure 11.8 – Trim Input Select

118 Trim Out Select

Range: See figure 11.9

Default: See figure 11.9

Access: 2 **Path:** Speed Command>Speed Trim

See also: 117, 119, 120

Specifies if Ref A speed reference is to be trimmed.

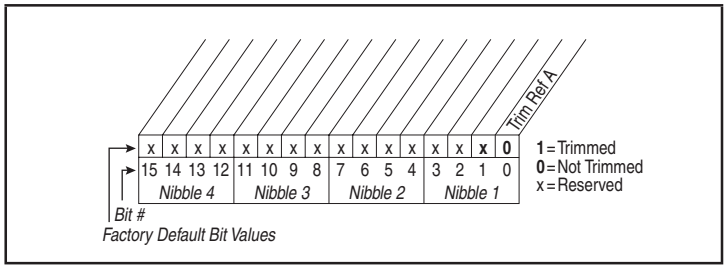


Figure 11.9 – Trim Out Select (118)

119 Trim Hi

Range: -/+ Maximum Speed [0.1 Hz]

Default: 60.0 Hz

Access: 2 **Path:** Speed Command>Speed Trim

See also: 82, 117, 322, 324

Scales the upper value of the Trim In Select (117) selection when the source is an analog input. This parameter should be set in conjunction with parameter 322 or 325.

120 Trim Lo

Range: -/+ Maximum Speed [0.1 Hz]

Default: 0.0 Hz

Access: 2 **Path:** Speed Command>Speed Trim

See also: 117, 323, 325

Scales the lower value of the Trim In Select (117) selection when the source is an analog input. This parameter should be set in conjunction with parameter 323 or 326.

121 Slip RPM @ FLA

Range: 0.0 to 1200.0 RPM

Default: Based on Motor NP RPM

Access: 2 **Path:** Speed Command>Slip Comp

See also: 61, 80, 122, 123

Sets the amount of compensation to drive output at motor FLA. If parameter 61 (Autotune) = 3 (Calculate), changes made to this parameter will not be accepted.

Important: Parameters in the Slip Comp Group (121-123) are used to enable and tune the slip compensation regulator. To allow the slip compensation regulator to control drive operation, Speed Mode (80) must be set to 1 (Slip Comp).

122 Slip Comp Gain

Range: 1.0 to 100.0 [0.1]

Default: 40.0

Access: 2 **Path:** Speed Command>Slip Comp

See also: 80, 121, 122

Sets the response time of slip compensation. Increasing the value will increase the slip compensation response.

123 Slip RPM Meter

Range: 0.0 to 300.0 RPM

Default: Read Only

Access: 2 **Path:** Speed Command>Slip Comp

See also: 80, 121, 122

Displays the present amount of slip adjustment being added to the motor command frequency.

124 PI Configuration

Range: See figure 11.10

Default: See figure 11.10

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 125-138

Selects specific features of the PI regulator (see appendix E.)

Proportional control (P) adjusts the output based on the magnitude of the error (larger error = proportionally larger correction). If the error is doubled, then the output of the proportional control is doubled; and, conversely, if the error is cut in half, then the output of the proportional output will be cut in half. With proportional control only, there is always an error, so the feedback and the reference are never equal.

Integral control (I) adjusts the output based on the duration of the error. The longer the error is present, the larger the correction output value will become. The integral control by itself is a ramped output correction and typically gives a smooth output correction and will continue to integrate until zero error is achieved. By itself, integral control is slower than many applications require and therefore is combined with proportional control (PI). It also contributes to overshoot of the correction value.

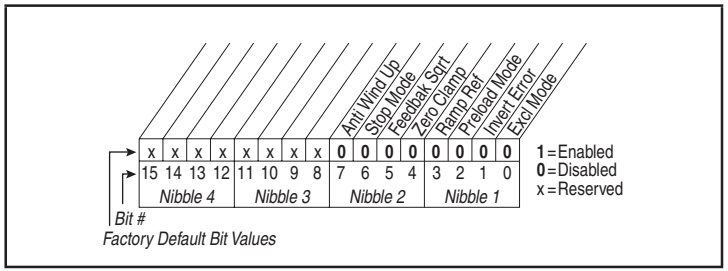


Figure 11.10 – PI Configuration (124)

Bit 0 - Excl Mode (Exclusive Mode)

- Enabled = Selects speed regulation (PI output used as speed command).
- Disabled = Selects trim regulation (PI output summed with speed command).

Bit 1 - Invert Error

- Enables/disables the option to invert the sign of the PI error signal. Enabling this feature creates a decrease in output for an increasing error and an increase in output for a decreasing error.

Bit 2 - Preload Mode

- Enabled = Initializes the PI integrator to the commanded speed while the PI is disabled.
- Disabled = The PI integrator is loaded with the PI Pre-load (133) while the PI is disabled.

Bit 3 - Ramp Ref

- Enables/disables ramping the PI reference using PI Feedback as the starting point and ramping to the selected PI Reference after PI is enabled. The active accel time is used for the PI ramp reference slew rate. The ramping is bypassed when the reference equals the setpoint. The ramp used is set by the active ramps (parameters 140 to 143).

Bit 4 - Zero Clamp

- Enables/disables option to limit operation so that the output frequency at the PI regulator always has the same sign as the master speed reference. This limits the possible drive action to one direction only. Output from the drive will be from zero to maximum frequency forward or zero to maximum frequency reverse.

Bit 5 - Feedback Sqrt (Square Root Feedback)

- Enables/disables the option of using the square root of the feedback signal as the PI feedback. This is used for pressure control because fans and pumps vary pressure with the square of the speed.

Bit 6 - Stop Mode

- When enabled, and a stop command is issued to the drive, the PI loop will continue to operate during the decel ramp.

  When disabled, the drive will perform a normal stop.

Bit 7 - Anti Wind Up

- When enabled, the PI loop will automatically prevent the integrator from creating an excessive error that could cause instability. The integrator will be controlled without the need for PI Reset or PI Hold inputs.

125 PI Control

Range:	See figure 11.11
Default:	See figure 11.11
Access:	2 **Path:** Speed Command>Process PI
See also:	80, 124-138

Controls the PI regulator. You can use a Datalink parameter or an assigned digital input to write to this parameter.

PI control allows the drive to take a reference signal (setpoint) and an actual signal (feedback) and automatically adjust the speed of the drive to match the actual signal to the reference.

Proportional control (P) adjusts the output based on the size of the error (larger error = proportionally larger correction).

Integral control (I) adjusts the output based on the duration of the error. The integral control by itself is a ramp output correction. This type of control gives a smoothing effect to the output and will continue to integrate until zero error is achieved.

By itself, integral control is slower than many applications require, and, therefore, is combined with proportional control (PI).

The purpose of the PI regulator is to regulate a process variable such as position, pressure, temperature, or flow rate, by controlling speed.

There are two ways the PI regulator can be configured to operate (see parameter 124):

- Process trim, which takes the output of the PI regulator and sums it with a master speed reference to control the process.
- Process control, which takes the output of the PI regulator as the speed command. No master speed reference exists, and the PI output directly controls the drive output.

Note that Speed Mode (80) must be set to Process PI (2).

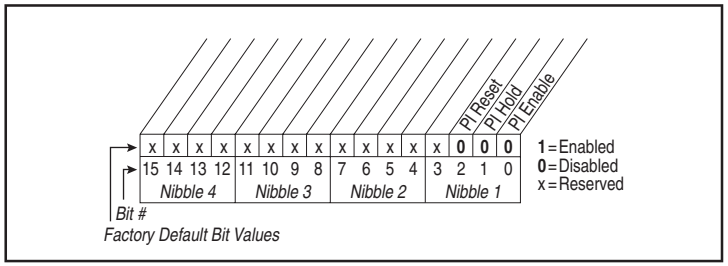


Figure 11.11 – PI Control (125)

Bit 0 - PI Enable

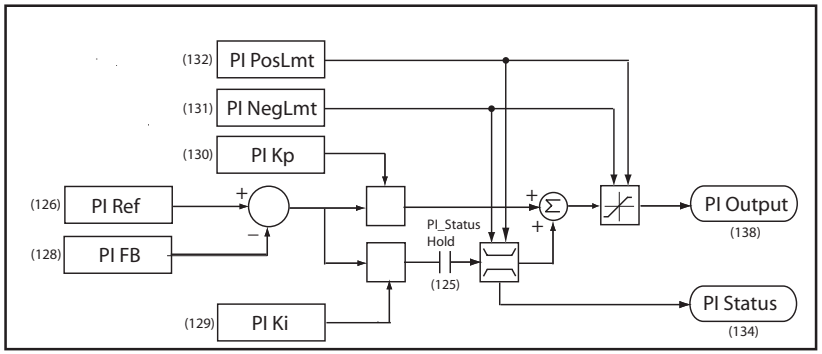
- Enables/disables the operation of the PI loop.

Bit 1 - PI Hold

- Enabled = The integrator for the outer control loop is held at the current level; that is, it will not increase.
- Disabled = The integrator for the outer PI control loop is allowed to increase.

Bit 2 - PI Reset

- Enabled = The integrator for the outer PI control loop is reset to zero.
- Disabled = The integrator for the outer PI control loop integrates normally.



126 PI Reference Sel

Range: 0 = PI Setpoint
1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level
10 = Master Ref
11 = Preset Spd 1
12 = Preset Spd 2
13 = Preset Spd 3
14 = Preset Spd 4
15 = Preset Spd 5
16 = Preset Spd 6
17 = Preset Spd 7
18 = Local OIM
19 = DPI Port 2
20 = DPI Port 3
21 = Reserved
22 = Network
23 = Reserved

Default: 0 = PI Setpoint

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 124-138

Selects the source of the outer control loop process PI reference signal.

127 PI Setpoint

Range: -/+100.00% of Maximum Process Value [0.01%]

Default: 50.00%

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 124-138

Provides an internal register value for the process setpoint when PI Reference Sel (126) is set to PI Setpoint.

128 PI Feedback Sel

Range: 0 = PI Setpoint
1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level
10 = Master Ref
11 = Preset Spd 1
12 = Preset Spd 2
13 = Preset Spd 3
14 = Preset Spd 4
15 = Preset Spd 5
16 = Preset Spd 6
17 = Preset Spd 7
18 = Local OIM
19 = DPI Port 2
20 = DPI Port 3
21 = Reserved
22 = Network
23 = Reserved

Default: 2 = Analog In 2

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 124-138

Selects the source of the outer control loop process PI feedback signal.

129 PI Integral Time

Range: 0.00 to 100.00 Sec [0.01 Sec]

Default: 2.00 Sec

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 124-138

Specifies the time required for the integral component of the PI regulator to reach 100% output. The shorter the integral time, the faster the integrator will read the process error.

130 PI Prop Gain

Range: 0.00 to 100.00 [0.01]

Default: 1.00

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 124-138

Sets the value for the proportional component of the PI regulator. The PI Hold bit of PI Control (125) must equal Enabled (1) for the PI regulator to be active.

PI Error x PI Prop Gain = PI Output

131 PI Lower Limit

Range: -/+Maximum Freq [0.1 Hz]
Default: -Maximum Freq
Access: 2 **Path:** Speed Command>Process PI
See also: 80, 124-138

Sets the lower limit of the PI output. This value must be less than the value set in PI Upper Limit (132).

132 PI Upper Limit

Range: -/+Maximum Freq [0.1 Hz]
Default: +Maximum Freq
Access: 2 **Path:** Speed Command>Process PI
See also: 80, 124-138

Sets the upper limit of the PI output. This value must be greater than the value set in PI Lower Limit (131).

133 PI Preload

Range: -/+Maximum Freq [0.1 Hz]
Default: 0.0 Hz
Access: 2 **Path:** Speed Command>Process PI
See also: 80, 124-138

Sets the value used to load into the PI Integrator while the PI regulator is disabled. This allows better dynamic performance when the regulator is enabled.

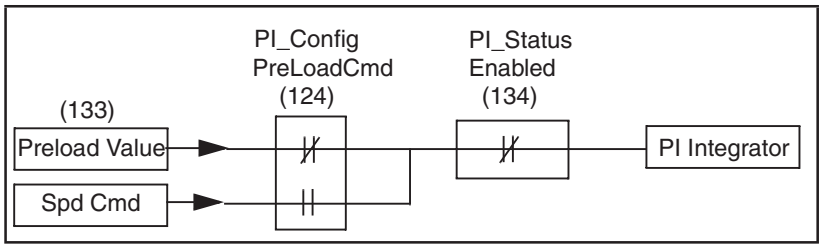


Figure 11.12 – PI Preload Value

134 PI Status

Range: See figure 11.13

Default: Read Only

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 124-138

The present state of the process PI regulator.

See parameter 125 for control of the PI functions.

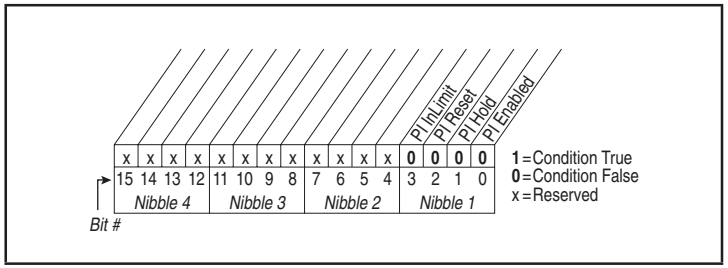


Figure 11.13 – PI Status (134)

Bit 0 - PI Enabled

- Indicates whether or not the process PI loop is enabled.

Bit 1 - PI Hold

- Is set to 1 to indicate when a digital input is configured for PI Hold and is turned on, or the PI Hold bit is set in PI Control (125).

Bit 2 - PI Reset

- Is set to 1 to indicate when the PI Integrator is being reset to zero.

Bit 3 - PI InLimit

- Is set to 1 to indicate when the PI output equals positive limit or negative limit.

135 PI Ref Meter

Range: -/+100.00% [0.01%]

Default: Read Only

Access: 2 **Path:** Speed Command>Process PI

See also: 80, 124 - 138

Present value of the process PI reference signal.

136 PI Fdback Meter

Range:	-/+100.00% [0.01%]
Default:	Read Only
Access:	2 **Path:** Speed Command>Process PI
See also:	80, 124 - 138

Present value of the process PI feedback signal.

137 PI Error Meter

Range:	-/+100.00% [0.01%]
Default:	Read Only
Access:	2 **Path:** Speed Command>Process PI
See also:	80, 124 - 138

Present value of the process PI error signal.

138 PI Output Meter

Range:	-/+Maximum Freq [0.1 Hz]
Default:	Read Only
Access:	2 **Path:** Speed Command>Process PI
See also:	80, 124 - 138

Present value of the process PI output signal.

$$\text{PI Output} \cong \text{PI Error} \times \text{PI Prop Gain} + \frac{\text{PI Error}}{\text{PI Integral Time}}$$

140 Accel Time 1
141 Accel Time 2

Range:	0.1 to 3600.0 sec [0.1 sec]
Default:	10.0 sec
Access:	140=0 **Path:** Dynamic Control>Ramp Rates 141=2
See also:	56, 142, 143, 146, 361-366

The Accel Time parameters set the rate at which the drive ramps to its output frequency after a start command or during an increase in command frequency (speed change). The rate established is the result of the following equation: Maximum Frequency - Minimum Frequency / Accel Time = Accel Rate

Two accel times exist to enable acceleration rate changes “on the fly” using a building automation system command, digital input, or F-Key, if configured (see Appendix B).

142 Decel Time 1
143 Decel Time 2

Range: 0.1 to 3600.0 Sec [0.1 sec]

Default: 10.0 sec

Access: 142=0 **Path:** Dynamic Control>Ramp Rates
143=2

See also: 142, 143, 146, 361-366

Sets the rate of deceleration for all speed decreases.

Max Speed / Decel Time = Decel Rate

Two decel times exist to enable deceleration rate changes “on the fly” using a network command, digital input, or F-Key, if configured (see Appendix B).

146 S Curve %

Range: 0 to 100% [1%]

Default: 0%

Access: 0 **Path:** Dynamic Control>Ramp Rates

See also: 140 - 143

Sets the percentage of acceleration or deceleration time that is applied to the ramp as S Curve. Time is entered as a percentage of accel or decel time and ramp times are extended, 1/2 at the beginning and 1/2 at the end of the ramp.

For example: Accel = 10 sec; S-Curve % = 25%

2.5 sec will be added to the accel time, 1.25 sec of rounding at each end of the ramp.

147 Current Lmt Sel

Range: 0 = Curr Lim Val
1 = Analog In 1
2 = Analog In 2

Default: 0 = Cur Lim Val

Access: 2 **Path:** Dynamic Control>Load Limits

See also: 148, 149, 322, 323, 325, 326

Selects the source for the adjustment of current limit (i.e., parameter, analog input, etc.). This parameter allows you to set current limit using an external analog signal.

If an analog input is selected (1, 2), Analog In*x* Lo = 0% limit (A), Analog In*x* Hi= 150% limit (A).

148 Current Lmt Val

Range: Based on Drive Type [0.1 Amps]

Default: Based on Drive Type (approx. 150% of Rated Amps)

Access: 0 **Path:** Dynamic Control>Load Limits

See also: 147, 149

Defines the current limit value when Current Lmt Sel (147) = Cur Lim Val.

149 Current Lmt Gain

Range: 0 to 5000 [1]

Default: 250

Access: 2 **Path:** Dynamic Control>Load Limits

See also: 147, 148

Sets the responsiveness of the current limit.

150 Drive OL Mode

Range: 0 = Disabled
1 = Reduce CLim
2 = Reduce PWM
3 = Both-PWM 1st

Default: 3 = Both-PWM 1st

Access: 1 **Path:** Dynamic Control>Load Limits

See also: 219

Selects the drive's response to increasing drive temperature. The drive could reduce current limit, PWM carrier, or both. A fault or alarm will be activated if an overload is detected.

151 CarrierFrequency

Range: 2 - 10 kHz [1 kHz]

Default: 4 kHz
2 kHz (248 amp drives only)

Access: 0 **Path:** Dynamic Control>Load Limits

See also: 146, 149

Sets the carrier frequency for the PWM output. Drive derating may occur at higher carrier frequencies. For derating information, refer to Appendix A.

155 Stop Mode A
156 Stop Mode B

Range: 0 = Coast
1 = Ramp
2 = Ramp to Hold
3 = DC Brake

Default: 155: 1 = Ramp
156: 0 = Coast

Access: 1 **Path:** Dynamic Control>Stop/Brake Modes

See also: 157-159, 361-366

Active stop mode. Stop Mode A is active unless Stop Mode B is selected by a digital input. This function allows you to switch between two stop modes using an external logic input.

ATTENTION: The user must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation may result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

157 DC Brake Lvl Sel

Range: 0 = DC Brake Lvl
1 = Analog In 1
2 = Analog In 2

Default: 0 = DC Brake Lvl

Access: 1 **Path:** Dynamic Control>Stop/Brake Modes

See also: 155, 156, 158, 159

Selects the source for DC Brake Level (158).

You can also select the amount of time that braking will be applied and the magnitude of current sed for braking. This mode of braking will generate up to 40% of the rated motor torque for braking. It is typically used for low inertia loads.

158 DC Brake Level

Range: 0 to (Rated Amps x 1.5) [0.1 Amps]

Default: Rated Amps

Access: 1 **Path:** Dynamic Control>Stop/Brake Modes

See also: 157-159

Defines the maximum DC brake current in percentage of drive rated current.

The DC braking voltage used in this function is created by a PWM algorithm and may not generate the smooth holding force needed for some applications.

ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used to stop the motor. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking. Failure to observe this precaution could result in damage to, or destruction of, equipment.

159 DC Brake Time

Range:	0.0 to 90.0 Sec [0.1 Sec]
Default:	0.0 Sec
Access:	1 **Path:** Dynamic Control>Stop/Brake Modes
See also:	155 - 158

Sets the amount of time DC brake current is “injected” into the motor.

160 Bus Reg Ki

Range:	0 to 5000 [1]
Default:	450
Access:	2 **Path:** Dynamic Control>Stop/Brake Modes
See also:	161, 162

Sets the responsiveness of the bus regulator. Adjust the value to improve the performance of the bus regulator to prevent nuisance overvoltage faults.

161 Bus Reg Mode A
162 Bus Reg Mode B

Range:	0 = Disabled 1 = Adjust Freq 2 = Dynamic Brak 3 = Both - DB 1st 4 = Both - Frq 1st
Default:	Mode A: 0 = Disabled Mode B: 0 = Disabled
Access:	2 **Path:** Dynamic Control>Stop/Brake Modes
See also:	160, 163, 361-366

Sets the method and sequence of the DC bus regulator voltage control. Choices are dynamic brake, frequency adjust, or both.

The user can select separate modes of control for Mode A and Mode B through a configured logic input. When Both (3 or 4) is selected, the bus controller will attempt to regulate the bus voltage using the selected technique first and then swith to the secondary method.

If a dynamic brake resistor is connected to the drive, Bus Reg Mode A and Bus Reg Mode B must be set to option 2, 3, or 4.

ATTENTION: The adjust freq portion of the bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. It forces the output frequency to be greater than commanded frequency while the drive's bus voltage is increasing towards levels that would otherwise cause a fault. However, it can also cause either of the following two conditions to occur:

- Fast positive changes in input voltage (more than a 10% increase within 6 minutes) can cause uncommanded positive speed changes; however, an OverSpeed Limit fault will occur if the speed reaches Max Speed + Overspeed Limit. If this condition is unacceptable, action should be taken to 1) limit supply voltages within the specification of the drive, and 2) limit fast positive input voltage changes to less than 10%. Without taking such actions, if this operation is unacceptable, the adjust freq portion of the bus regulator function must be disabled (see parameters 161 and 162).
- Actual deceleration times can be longer than commanded deceleration times; however, a Decel Inhibit fault is generated if the drive stops decelerating altogether. If this condition is unacceptable, the adjust freq portion of the bus regulator must be disabled (see parameters 161 and 162). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

Note that these faults are not instantaneous. Test results have shown that it takes between 2 and 12 seconds for a fault to occur.

163 DB Resistor Type

Range: 0 = Internal Res
1 = External Res
2 = None

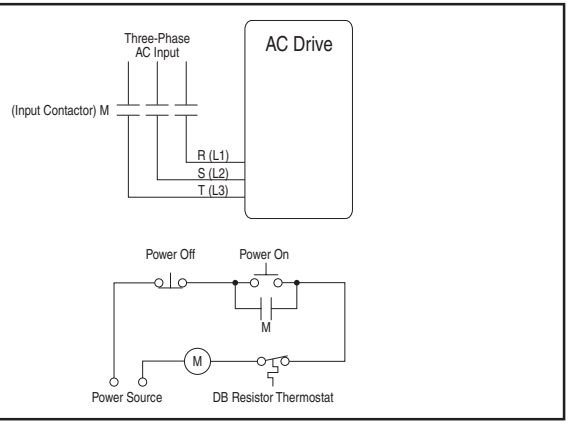
Default: 0 = Internal Res

Access: 1 **Path:** Dynamic Control>Stop/Brake Modes

See also: 161, 162

Selects whether the internal or an external DB resistor option will be used. An internal DB resistor is one that can be mounted inside the footprint of the drive. External DB resistors are panel mounted separately.

ATTENTION: AC drives do not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from overtemperature or the protective circuit shown below, or equivalent, must be supplied.



164 Bus Reg Kp

Range: 0 to 10000

Default: 1200

Access: 2 **Path:** Dynamic Control>Stop/Brake Modes

See also:

Proportional gain for the bus regulator. Used to adjust regulator response.

165 Bus Reg Kd

Range: 0 to 10000
Default: 1000
Access: 2 **Path:** Dynamic Control>Stop/Brake Modes
See also:

Derivative gain for the bus regulator. Used to control regulator overshoot.

168 LevelSense Start

Range: 0 = Disabled
1 = Enabled
Default: 0 = Disabled
Access: 2 **Path:** Dynamic Control>Stop/Restart Modes
See also: 160, 163

ATTENTION: Be aware of the following:

- Setting parameter 168 to 1 (Enabled) immediately applies output power to the motor when all start conditions are met.
- If the drive is running from the terminal block, LevelSense Start is enabled, and a fault occurs, the drive coasts to rest and generates a fault. In this case, resetting and clearing the fault immediately restarts the drive without any change to the start or stop input states.

When this function is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Enables/disables a feature to issue a start or run command and automatically run at the commanded speed when drive input power is applied.

Disabled: The drive starts on the open-to-closed transition of the control source start input when no start inhibit conditions are present (edge-sensitive detection).

Enabled: The drive starts when the control source start input is closed, no start inhibit conditions are present, and power is applied (level-sensitive detection).

Note that this feature (LevelSense Start) requires a digital input configured for run or start and a valid start contact.

169 Flying Start En

Range: 0 = Disabled
1 = Enabled

Default: 0 = Disabled

Access: 2 **Path:** Dynamic Control>Stop/Restart Modes

See also: 170

Enables/disables the function which allows the drive to start a spinning motor at actual RPM when a start command is issued.

Normally, when a drive is started in its normal mode, it initially applies a frequency of 0 Hz and ramps to the desired frequency. If the drive is started into a spinning motor, without Flying Start enabled, large currents will be generated and an overcurrent trip may result.

In Flying Start mode, the drive's response to a start command will be to identify the motor's speed and apply a voltage that is synchronized in frequency and amplitude to the counter emf of the spinning motor. The motor will then accelerate to the desired frequency.

170 Flying StartGain

Range: 20 to 32767 [1]

Default: 4000

Access: 2 **Path:** Dynamic Control>Stop/Restart Modes

See also: 169

Adjusts the responsiveness of the flying start function. Increasing the value in this parameter increases the responsiveness of the flying start function.

174 Auto Rstrt Tries

Range: 0 to 9 [1]

Default: 0 (Disabled)

Access: 1 **Path:** Dynamic Control>Stop/Restart Modes

See also: 175, table 12.6 for auto-resettable faults

ATTENTION: Equipment damage and/or personal injury may result if parameter 174 is used in an inappropriate application. Do not use this function without considering applicable local, national, and international codes, standards, regulations, or industry guidelines.

ATTENTION: The drive may start immediately after a fault is auto-reset when LevelSense Start (168) is set to Enabled.

When LevelSense Start is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Important: The drive will re-start after a reset if the start input is still asserted.

Specifies the maximum number of times the drive attempts to reset a fault and restart when the auto restart feature is enabled.

The auto restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. Only certain faults are permitted to be reset, see chapter 12 for more information.

When the auto restart feature is enabled (that is, Auto Rstrt Tries is set to a value greater than zero), and an auto-resettable fault occurs, the drive will stop. After the number of seconds in Auto Restrt Delay (175) has elapsed, the drive will automatically reset the faulted condition. The drive will then issue an internal start command to start the drive.

If another auto-resettable fault occurs, the cycle will repeat up to the number of attempts specified in Auto Rstrt Tries.

If the drive faults repeatedly for more than the number of attempts specified in Auto Rstrt Tries with less than five minutes between each fault, the drive will remain in the faulted state. The fault Auto Rstrt Tries will be logged in the fault queue.

The auto restart feature is disabled when the drive is stopping and during autotuning. Note that a DC Hold state is considered stopping.

The following conditions will abort the reset/run process:

- Issuing a stop command from any control source. (Note that removal of a 2-wire run-fwd or run-rev command is considered a stop command.)
- Issuing a fault reset command from any active source.
- Removing the enable input signal.
- Setting Auto Restrt Tries to zero.
- Occurrence of a fault that is not auto-resettable.
- Removing power from the drive.
- Exhausting an auto-reset/run cycle.

175 Auto Rstrt Delay

Range: 0.5 to 30.0 Sec [0.1 Sec]
Default: 1.0 Sec
Access: 1 **Path:** Dynamic Control>Stop/Restart Modes
See also: 174

Sets the time between restart attempts when the auto restart feature is enabled. Refer to Auto Rstrt Tries (174) for more information about the auto restart feature.

178 Sleep-Wake Mode

Range: 0 = Disabled
1 = Direct
Default: 0 = Disabled
Access: 2 **Path:** Dynamic Control>Restart Modes
See also:

Enables the Sleep-Wake function.

ATTENTION: Enabling the Sleep-Wake function can cause unexpected machine motion during the Wake mode. Do not use this function without considering the information in the table below. Failure to observe this precaution could result in personal injury or damage to equipment.

Important: When this function is enabled, the following conditions must be met:

- A proper minimum value must be set for Sleep Level (182).
- At least one of the following must be programmed in Digital Inx Sel (361 to 366): Enable, Stop=CF, Run, Run Forward, Run Reverse.

Table 11.3 – Sleep-Wake Mode

	Start Requirements When Sleep-Wake Mode is Enabled			
Configured Digital inputs	**At Power Up**	**After Fault Reset**		**After Stop**
		Stop-CF (OIM or TB)	Clear Faults (TB or VS Utilities)	OIM, TB, or Network Stop
Stop	Stop Closed Wake Signal	Stop Closed Wake Signal Start/Run Signal	Stop Closed Wake Signal	Stop Closed Wake Signal Start/Run Signal
Enable	Enable Closed Wake Signal	Enable Closed Wake Signal Start/Run Signal	Enable Closed Wake Signal	Enable Closed Wake Signal Start/Run Signal
Run Run Forward Run Reverse	Wake Signal Run Closed	Wake Signal Run Signal	Wake Signal Run Closed	Wake Signal Run Signal

Sleep-Wake Operation

The basic operation of this function is to start (wake) the drive when an analog signal is greater than or equal to a user-specified wake level and stop the drive when an analog signal is less than or equal to a user-specified sleep level.

Assuming all drive permissive conditions are met, the drive will start when Sleep-Wake Mode (178) is enabled (= Direct) and the absolute value of the Sleep-Wake Ref (179) is greater than the programmed Wake Level (180) for longer than the programmed Wake Time (181).

The drive will stop when the absolute value of the Sleep-Wake Ref (179) is less than the programmed Sleep Level (182) for longer than the programmed Sleep Time (183).

While the drive is measuring the time above Wake Level (180), it will indicate a "Waking" alarm. If Sleep-Wake Ref (179) goes above Sleep Level (182) or below Wake Level (180) the corresponding timer is reset (Wake timer and Sleep timer, respectively).

While the drive is "awake", all other active stop commands will be honored immediately (i.e. no Sleep timer). However, after a stop is commanded, a new start command while Sleep-Wake Ref (179) is above Sleep Level (182) will be required to reset the sleep-wake controller. Similarly, while the drive is “asleep”, the selected logic control source can still start the drive. In this case, the sleep-wake controller must also be reset (stop, then restart with analog input above sleep level).

If Logic Source Sel (089) is set to All Ports, the drive can only be started when Sleep-Wake Ref (179) is greater than Sleep Level (182). Here the sleep-wake controller remains active and does not need to be reset. If no Start signal has been configured to reset the sleep-wake controller, drive power can be cycled to provide the reset function.

Sleep Level (182) and Wake Level (180) are adjustable while the drive is "awake". If these levels are set incorrectly, the "Sleep Config" alarm is set. If the current configuration is not corrected, the drive will stop after the programmed Sleep Time (183).

Even though the Sleep-Wake feature is enabled, the operation of other start modes is unchanged (e.g. if Level Sense Start is set to Enabled, Logic Source Select is set to All Ports, and a start command is asserted, the drive will start immediately after Sleep-Wake Ref (179) reaches the sleep level).

The Sleep-Wake feature can be overridden in additional ways:

- The OIM Control digital input allows an attached OIM to start the drive by overriding the Sleep-Wake Sleep signal (i.e. the analog input is below the Sleep level). Once overridden by the OIM, the Sleep-Wake analog input will no longer be able to start or stop the drive until it is restarted while the analog input is above the Sleep level.
- Jog (from an active logic source only) will override Sleep-Wake. While Jog is active, the Sleep-Wake analog input will not be able to Start or Stop the drive.

179 Sleep-Wake Ref

Range:	1 = Analog In 1 2 = Analog In 2
Default:	2 = Analog In 2
Access:	2 **Path:** Dynamic Control>Restart Modes
See also:	178 - 183

Selects the source of the analog input controlling the Sleep-Wake function.

180 Wake Level

Range:	Sleep Level to 20.000 mA, 10.000 V [0.001 mA, 0.001 V, based on Anlg In Config [320]]
Default:	6.000 mA, 6.000 V
Access:	2 **Path:** Dynamic Control>Restart Modes
See also:	178 - 183

Defines the analog input signal level that will start the drive.

181 Wake Time

Range: 0.0 to 600.0 sec [0.1 sec]

Default: 1.0 sec

Access: 2 **Path:** Dynamic Control>Restart Modes

See also: 178 - 183

Defines the amount of time at or above Wake Level before a start command is issued.

182 Sleep Level

Range: 4.000 mA, 0.000 V to Wake Level
[0.001 mA or 0.001 V, based on Anlg In Config [320]]

Default: 5.000 mA, 5.000 V

Access: 2 Path: Dynamic Control>Restart Modes

See also: 178 - 183

Defines the analog input signal level that will stop the drive.

183 Sleep Time

Range: 0.0 to 600.0 sec [0.1 sec]

Default: 1.0 sec

Access: 2 Path: Dynamic Control>Restart Modes

See also: 178 - 182

Defines the amount of time at or below Sleep Level before a stop command is issued.

184 Power Loss Mode

Range: 0 = Coast
1 = Decel
2 = Continue
3 = Coast input
4 = Decel input

Default: 0 = Coast

Access: 1 **Path:** Dynamic Control>Stop/Power Loss

See also: 184

Sets the reaction to a loss of input power. Power loss is recognized when:

DC bus voltage is ≤ 73% of DC Bus Memory and Power Loss Mode is set to Coast.

DC bus voltage is ≤ 82% of DC Bus Memory and Power Loss Mode is set to Decel.

185 Power Loss Time

Range: 0.0 to 60.0 Sec [0.1 Sec]

Default: 0.5 Sec

Access: 1 **Path:** Dynamic Control>Stop/Power Loss

See also: 184

Sets the time that the drive will remain in power loss mode before a fault is issued.

186 Power Loss Level

Range: 0.0 to 999.9 V [0.1 V]

Default: 0.0 V

Access: 2 Path: Dynamic Control>Power Loss

See also: 184

Sets the level at which the Power Loss Mode (184) selection will occur.

190 Direction Mode

Range:	0 = Unipolar 1 = Bipolar 2 = Reverse Dis
Default:	0 = Unipolar
Access:	0 **Path:** Utility>Direction Config
See also:	320 - 327, 361 - 366

Selects the method for control of drive direction.

ATTENTION: Setting parameter 190 to 0 or 1 may cause unwanted motor direction. Verify driven machinery cannot be damaged by reverse rotation before changing the setting of this parameter to 0 or 1. Failure to observe this precaution could result in damage to, or destruction of, equipment.

Unipolar = Drive receives unsigned reference signal and a separate direction command (from a logic source such as digital inputs or a DPI port).

Bipolar = Drive receives signed reference.

Reverse Disable = Drive receives signed reference; however, regardless of the reference, the drive is not permitted to reverse.

192 Save OIM Ref

Range:	See figure 11.14
Default:	See figure 11.14
Access:	2 **Path:** Utility>OIM Ref Config
See also:	

Enables a feature to save the present frequency reference value issued by the OIM to drive memory on power loss. Value is restored the OIM on power up.

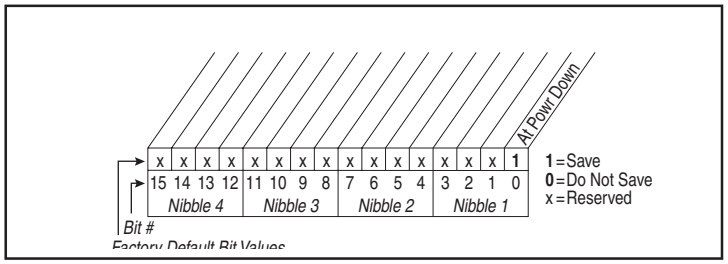


Figure 11.14 – Save OIM Ref (192)

193 Man Ref Preload

Range: 0 = Disabled
1 = Enabled

Default: 1 = Enabled

Access: 2 **Path:** Utility>OIM Ref Config

See also: 320 - 327, 361 - 366

Enables/disables a feature to automatically load the present auto frequency reference value into the OIM when Manual is selected. Allows smooth speed transition from Auto to Manual mode. You can adjust the manual speed setpoint from the OIM.

194 Save MOP Ref

Range: See figure 11.15

Default: At Pwrdown

Access: 2 **Path:** Utility>MOP Config

See also:

Enables/disables the feature that saves the present MOP (motor-operated potentiometer) frequency reference at power down or at stop.

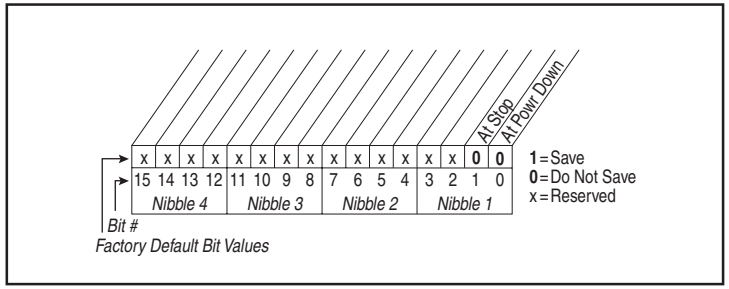


Figure 11.15 – Save MOP Ref (194)

195 MOP Rate

Range: 0.2 to Maximum Freq [0.1 Hz/sec]

Default: 1.0 Hz/sec

Access: 2 **Path:** Utility>MOP Config

See also:

Sets the rate of change of the MOP reference in response to a MOP inputs.

196 Param Access Lvl

Range: 0 = Basic
1 = Standard
2 = Advanced

Default: Read Only

Access: 0 **Path:** Utility>Drive Memory

See also:

Displays the present parameter access level. Refer to chapter 10 for more information about parameter access levels.

197 Reset To Defalts

Range: 0 = Ready
1 = Factory
2 = Low Voltage
3 = High Voltage

Default: 0 = Ready

Access: 0 **Path:** Utility>Drive Memory

See also:

Resets all parameter values to defaults. Option 1 resets the drive to factory settings. Options 2 and 3 resets the drive to alternate voltage and current rating.

Important: On frame 5 and 6 drives, the internal fan voltage may have to be changed when using options 2 or 3. See section 3.1.1.4.

198 Load Frm Usr Set

Range: 0 = Ready
1 = User Set 1
2 = User Set 2
3 = User Set 3

Default: 0 = Ready

Access: 1 **Path:** Utility>Drive Memory

See also: 199

Loads a previously saved set of parameter values from a selected user set location in drive non-volatile memory to active drive memory.

An F-Key on the LCD OIM can be configured for this function. Refer to Appendix B.

199 Save To User Set

Range: 0 = Ready
1 = User Set 1
2 = User Set 2
3 = User Set 3

Default: 0 = Ready

Access: 1 **Path:** Utility>Drive Memory

See also: 198

Saves the parameter values in active drive memory to a user set in drive non-volatile memory.

An F-Key on the LCD OIM can be configured for this function. Refer to Appendix B.

200 Reset Meters

Range: 0 = Ready
1 = MWh
2 = Elapsed Time

Default: 0 = Ready

Access: 1 **Path:** Utility>Drive Memory

See also:

Resets selected meters to zero.

201 Language

Range: 0 = Not Selected
1 = English
2 = French
3 = Spanish
4 = Italian
5 = German
6 = Reserved
7 = Portuguese

Default: 0 = Not Selected

Access: 2 **Path:** Utility>Drive Memory

See also:

Selects the display language when using an LCD OIM.

202 Voltage Class

Range: 2 = Low Voltage
3 = High Voltage

Default: Based on Drive Type

Access: 2 **Path:** Utility>Drive Memory

See also: 55

Resets selected parameters that change the drive voltage rating, current rating, scaling, and motor data. Maximum Frequency (55) will be affected by changing this parameter.

Important: On frame 5 and 6 drives, the internal fan voltage may have to be changed when using options 2 or 3. See section 3.1.1.4.

203 Drive Checksum

Range: 0 to 65535 [1]

Default: Read Only

Access: 2 **Path:** Utility>Drive Memory

See also:

Provides a checksum value that indicates whether or not a change in drive programming has occurred (data values only).

204 Dyn UserSet Cnfg

Range: See figure 11.16.

Default: See figure 11.16.

Access: 2 **Path:** Utility>Drive Memory

See also: 205, 206, 361-366

Configures behavior of User Sets. Dynamic switching between sets is permitted from either digital input states of parameter value.

Bit 0 - Dynamic Mode - Specifies User Sets operating mode.

0 = Disabled: Disabled causes normal operation.

1 = Enabled: Enabled selects Dynamic Mode. While enabled, parameters changes are not saved in active non-volatile storage.

Bit 1 - Ctrl Source - Defines which source controls the selection of user sets, while Dynamic Mode is enabled.

0 = Dig. Inputs: Dig. Inputs refers to UserSetBitn defined by Terminal Block Input(s) from Digital In 1-6 Sel (361-366).

1 = DynUsrSetSel: DynUsrSetSel (205) determines the active User Set.

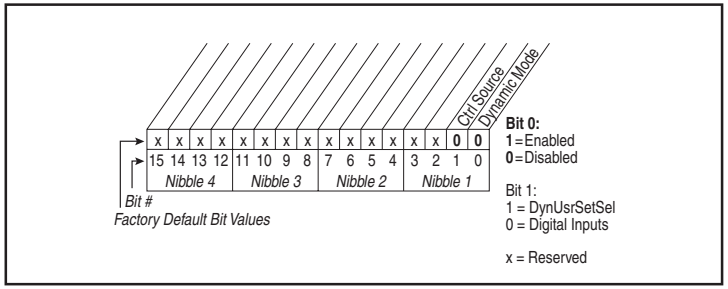


Figure 11.16 – Dyn UserSet Cnfg

205 DynUsrSetSel

Range: See figure 11.17.

Default: See figure 11.17.

Access: 2 **Path:** Utility>Drive Memory

See also: 204, 206

Controls which User Set is in memory when Ctrl Source (bit 1) of DynUsrSetCnfg (204) is set to DynUsrSetSel.

Bit 0 - UserSetBit0

0 = Disabled

1 = Enabled

Bit 1 -UserSetBit1

0 = Disabled

1 =Enabled

Table 11.4 – Dynamic User Set Mode

UserSetBit1	UserSetBit0	UserSet Loaded in Memory
0	0	User Set 1
0	1	User Set 2
1	0	User Set 3
1	1	User Set 3

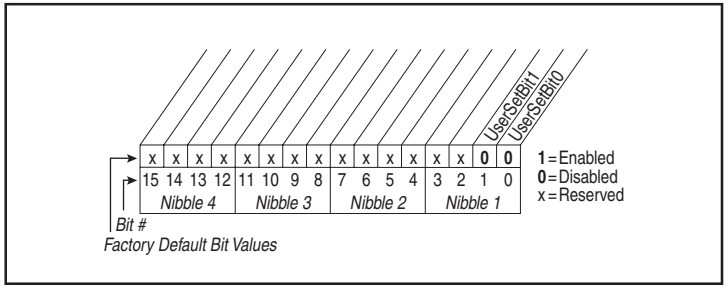


Figure 11.17 – DynUsrSetSel

206 Dyn UserSet Actv

Range: 0 = Normal Mode (Dynamic Mode Disabled)
1 = User Set 1
2 = User Set 2
3 = User Set 3

Default: Read Only

Access: 2 **Path:** Utility>Drive Memory

See also: 204, 205

Displays which User Set was last loaded into active memory. User parameter changes are allowed after a User Set is restored, but will not be detected or annunciated.

209 Drive Status 1

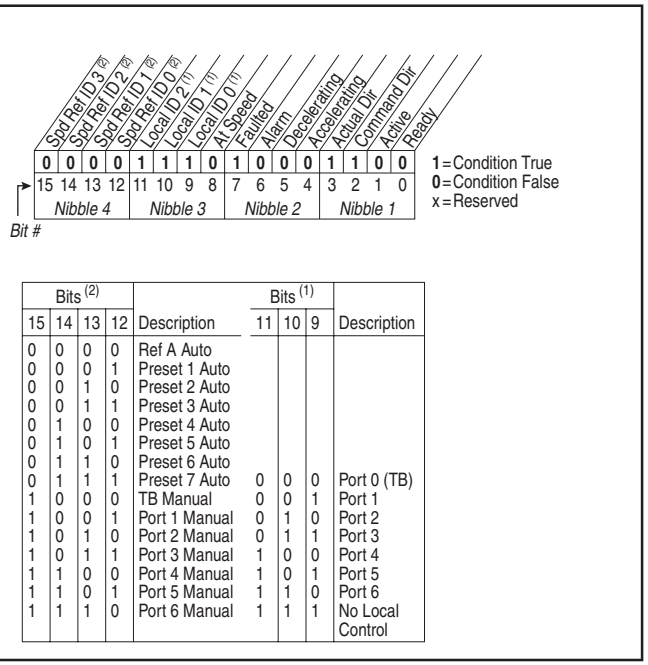
Range: See figure11.18

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 210

Present operating status of the drive.



Bits (2)					Bits (1)			
15	14	13	12	Description	11	10	9	Description
0	0	0	0	Ref A Auto				
0	0	0	1	Preset 1 Auto				
0	0	1	0	Preset 2 Auto				
0	0	1	1	Preset 3 Auto				
0	1	0	0	Preset 4 Auto				
0	1	0	1	Preset 5 Auto				
0	1	1	0	Preset 6 Auto				
0	1	1	1	Preset 7 Auto	0	0	0	Port 0 (TB)
1	0	0	0	TB Manual	0	0	1	Port 1
1	0	0	1	Port 1 Manual	0	1	0	Port 2
1	0	1	0	Port 2 Manual	0	1	1	Port 3
1	0	1	1	Port 3 Manual	1	0	0	Port 4
1	1	0	0	Port 4 Manual	1	0	1	Port 5
1	1	0	1	Port 5 Manual	1	1	0	Port 6
1	1	1	0	Port 6 Manual	1	1	1	No Local Control

Figure 11.18 – Drive Status 1 (209)

Bit	Function	Description
0	Ready	Drive ready; no faults or inhibits.
1	Active	Drive outputting voltage.
2	Commanded Dir	
3	Active Dir	Motor direction = setpoint direction.
4	Accelerating	Motor accelerating.
5	Decelerating	Motor decelerating.
6	Alarm	Alarm active.
7	Faulted	Drive faulted.
8	At Speed	Output frequency = Setpoint frequency.

210 Drive Status 2

Range: See figure11.19

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 209

Present operating condition of the drive.

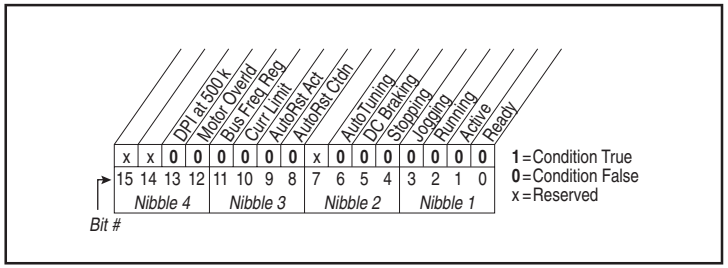


Figure 11.19 – Drive Status 2 (210)

Bit	Name	Description
0	Ready	No start inhibits are active.
1	Active	Drive is generating output voltage to the motor.
2	Running	Drive is generating output voltage to the motor, run has been selected.
3	Jogging	Drive is in jog mode.
4	Stopping	Drive is stopping.
5	DC Braking	DC braking is active.
6	Auto Tuning	Tuning function is active.
8	AutoRst Ctdn:	Auto Restart Countdown. Refer to parameter 174.
9	AutoRst Ac:	Auto Restart Active. Refer to parameter 174.
10	Curr Limit:	Drive is in current limit.
11	Bus Freq Reg:	Drive is regulating bus frequency.
12	Motor Overld:	Motor overload is active.
13	DPI @ 500 K	DPI communications is operating at 500 kbaud (1), 125 kbaud (0)

211 Drive Alarm 1

Range: See figure11.20

Default: Read Only

Access: 1 **Path:** Utility>Diagnostics
Utility>Alarms

See also: 212, 259

Indicates Type 1 alarm conditions that currently exist in the drive. Note that for alarm conditions not configured in Alarm Config 1 (259), the status indicated will be a zero.

Refer to chapter 12, Troubleshooting the Drive, for more information about alarms.

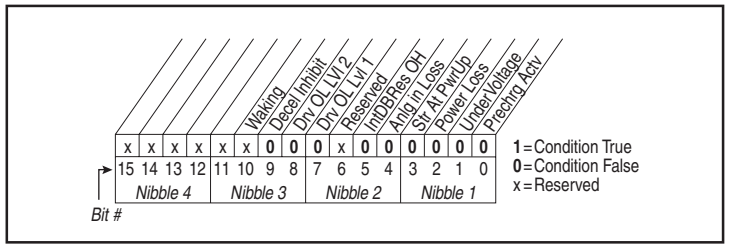


Figure 11.20 – Drive Alarm 1 (211)

212 Drive Alarm 2

Range: See figure 11.21

Default: Read Only

Access: 1 **Path:** Utility>Diagnostics
Utility>Alarms

See also: 211

Indicates Type 2 alarm conditions that currently exist in the drive. Refer to chapter 12, Troubleshooting the Drive, for more information about alarms.

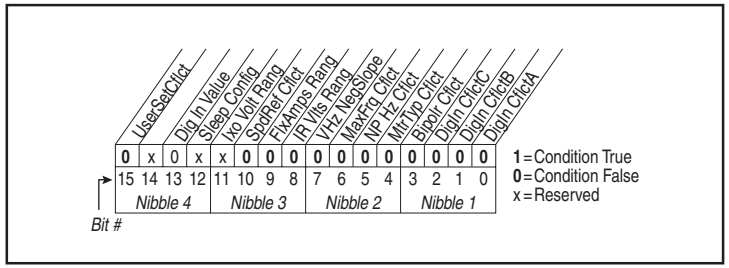


Figure 11.21 – Drive Alarm 2 (212)

213 Speed Ref Source

Range: 0 = PI Output
1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level
10 = Jog Speed
11 = Preset Spd 1
12 = Preset Spd 2
13 = Preset Spd 3
14 = Preset Spd 4
15 = Preset Spd 5
16 = Preset Spd 6
17 = Preset Spd 7
18 = Local OIM
19 = DPI Port 2
20 = DPI Port 3
21 = Reserved
22 = Network
23 = Reserved

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 90, 93, 96, 101

Displays the source of the speed reference of the drive.

214 Start Inhibits

Range: See figure 11.22

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also:

Displays the source input currently preventing the drive from starting.

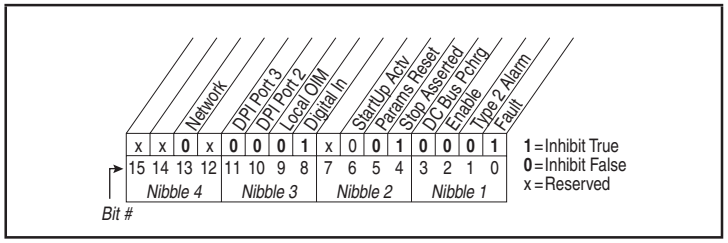


Figure 11.22 – Start Inhibits (214)

215 Last Stop Source

Range: 0 = Pwr Removed
1 = Local OIM
2 = DPI Port 2
3 = DPI Port 3
4 = Reserved
5 = Network
6 = Reserved
7 = Digital In
8 = Fault
9 = Not Enabled
10 = Sleep
11 = Jog

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also:

Displays the source that initiated the most recent stop command. It will be cleared (set to 0) during the next start sequence.

216 Dig In Status

Range: See figure 11.23

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics
Inputs & Outputs>Digital Inputs

See also: 361-366

Current state of the digital inputs on the terminal block.

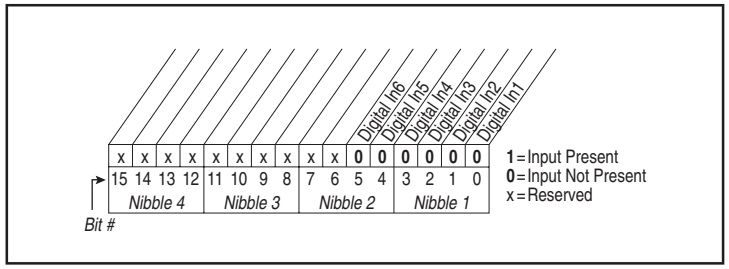


Figure 11.23 – Dig In Status (216)

217 Dig Out Status

Range: See figure 11.24

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics
Inputs & Outputs>Digital Outputs

See also: 380-384

Current state of the digital outputs.

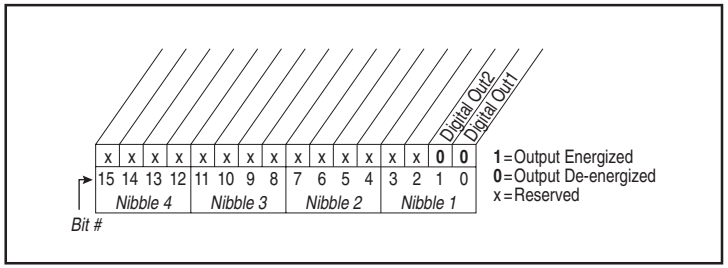


Figure 11.24 – Dig Out Status (217)

218 Drive Temp

Range: -/+100 deg C [0.1 deg C]

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also:

Present operating temperature of the drive power section.

219 Drive OL Count

Range: 0.0 to 100.0% [0.1%]

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 150

Accumulated percentage of drive overload. Continuously operating the drive over 100% of its rating will increase this value to 100% and cause a drive fault.

220 Motor OL Count

Range: 0.0 to 100.0 % [1.0%]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 47, 48

Accumulated percentage of motor overload. Continuously operating the motor over 100% of the motor overload setting will increase this value to 100% and cause a drive fault.

224 Fault Frequency

Range: 0.0 to +/-400.0 Hz [0.1 Hz]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 225-230

Captures and displays the output frequency of the drive at the time of the last fault.

225 Fault Amps

Range: 0.0 to Rated Amps x 2 [0.1 Amps]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 224-230

Captures and displays motor amps at the time of the last fault.

226 Fault Bus Volts

Range: 0.0 to Max Bus Volts [0.1 VDC]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 224-230

Captures and displays the DC bus voltage of the drive at the time of the last fault.

227 Status 1 @ Fault

Range: See figure 11.25

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 209, 224-230

Captures and displays Drive Status bit pattern at the time of the last fault.

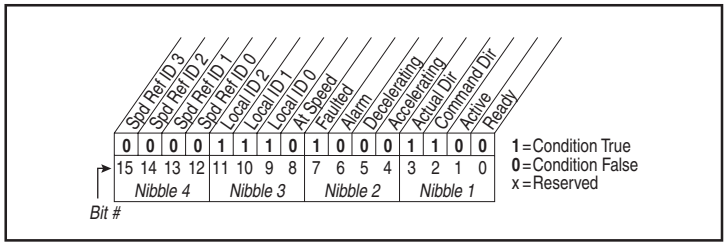


Figure 11.25 – Status 1 @ Fault (227)

See parameter 209 for bit descriptions.

228 Status 2 @ Fault

Range: See figure 11.26

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 210, 224-230

Captures and displays Drive Status bit pattern at the time of last fault.

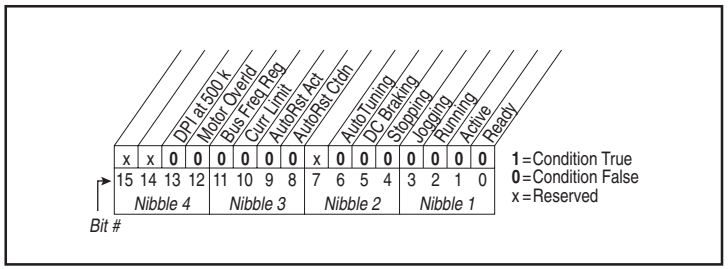


Figure 11.26 – Status 2 @ Fault (228)

See parameter 210 for bit descriptions.

229 Alarm 1 @ Fault

Range:	See figure 11.27
Default:	Read Only
Access:	1 **Path:** Utility>Diagnostics
See also:	211, 224-230

Captures and displays Drive Alarm status at the time of the last fault.

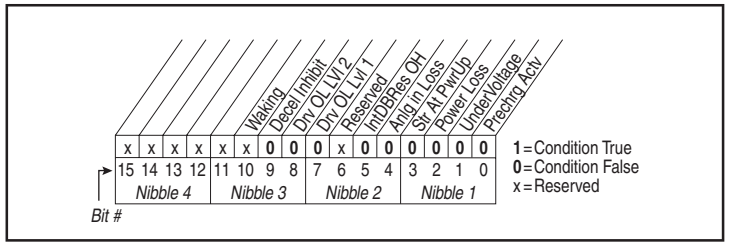


Figure 11.27 – Alarm 1 @ Fault (229)

See parameter 211 for bit descriptions.

230 Alarm 2 @ Fault

Range:	See figure 11.28
Default:	Read Only
Access:	1 **Path:** Utility>Diagnostics
See also:	211, 221-230

Captures and displays Drive Alarm status bit pattern at the time of last fault.

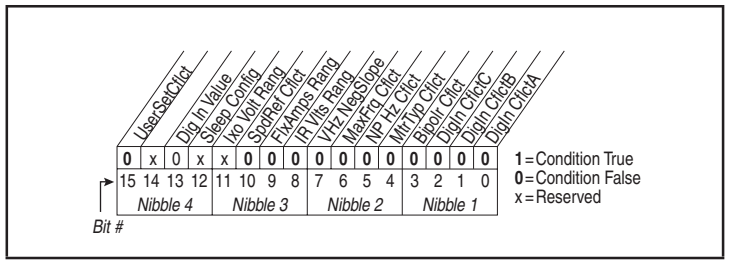


Figure 11.28 – Alarm 2 @ Fault (230)

See parameter 212 for bit descriptions.

234 Testpoint 1 Sel

Range: 0 to 65535 [1]
Default: 499
Access: 2 **Path:** Utility>Diagnostics
See also: 235

Selects the function whose value is displayed in Testpoint 1 Data (235). These are internal values that are not accessible through parameters.

Factory diagnostic function.

235 Testpoint 1 Data

Range: 0 to 4,294,697,295 [1]
Default: 0
Access: 2 **Path:** Utility>Diagnostics
See also: 234

The present value of the function selected in Testpoint 1 Sel (234).

Factory diagnostic function.

236 Testpoint 2 Sel

Range: 0 to 65535 [1]
Default: 499
Access: 2 **Path:** Utility>Diagnostics
See also: 237

Selects the function whose value is displayed in Testpoint 2 Data (237). These are internal values that are not accessible through parameters.

Factory diagnostic function.

237 Testpoint 2 Data

Range: 0 to 4,294,967,295 [1]
Default: 0
Access: 2 **Path:** Utility>Diagnostics
See also: 236

The present value of the function selected in Testpoint 2 Sel (236).

Factory diagnostic function.

238 Fault Config 1

Range: See figure 11.29

Default: See figure 11.29

Access: 2 **Path:** Utility>Faults

See also:

Enables/disables annunciation of the faults shown in figure 11.29.

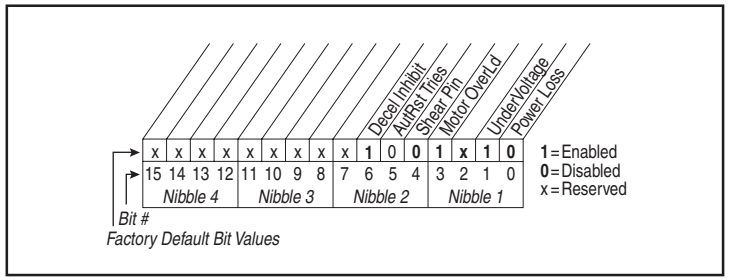


Figure 11.29 – Fault Config 1 (238)

240 Fault Clear

Range: 0 = Ready
1 = Clear Faults
2 = Clr Flt Que

Default: 0 = Ready

Access: 2 **Path:** Utility>Faults

See also: 241

Resets a fault and clears the fault queue.

241 Fault Clear Mode

Range: 0 = Disabled
1 = Enabled

Default: 1 = Enabled

Access: 2 **Path:** Utility>Faults

See also: 240

Enables/disables a fault reset (clear faults) attempt from any source. This does not apply to fault codes stored in the fault queue, which are cleared indirectly via other actions.

242 Power Up Marker

32

Range: 0.0000 to 4,294,967.2925 Hr [0.0001 Hr]

Default: Read Only

Access: 2 **Path:** Utility>Faults

See also: 244, 246, 248, 250

Elapsed hours since drive power up. This value will rollover to 0 after the drive has been powered on for more than the maximum value shown.

259 Alarm Config 1

Range: See figure 11.30

Default: See figure 11.30

Access: 2 **Path:** Utility>Alarms

See also:

Selects conditions that will initiate a drive alarm.

Refer to chapter 12, Troubleshooting the Drive, for alarm definitions.

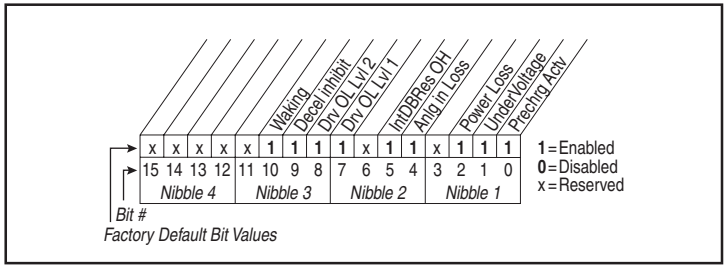


Figure 11.30 – Alarm Config 1 (259)

271 Drive Logic Rslt

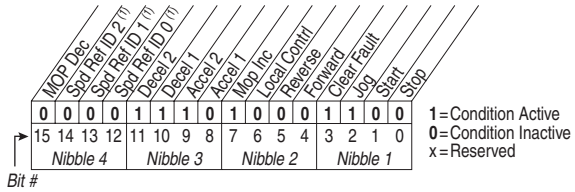
Range: See figure 11.31

Default: Read Only

Access: 2 **Path:** Communication>Comm Control

See also:

The output of the logic function control block resulting from the combination of all port requests and masking functions. Each bit or set of bits represent a command to the drive.



Bits(1)			
14	13	12	Description
0	0	0	No Command - Man. Mode
0	0	1	Ref A Auto
0	1	0	Preset 2 Auto
0	1	1	Preset 3 Auto
1	0	0	Preset 4 Auto
1	0	1	Preset 5 Auto
1	1	0	Preset 6 Auto
1	1	1	Preset 7 Auto

Figure 11.31 – Drive Logic Rslt (271)

272 Drive Ref Rslt

Range: 0 to 32767 [1]

Default: Read Only

Access: 2 **Path:** Communication>Comm Control

See also:

Present frequency reference scaled as a DPI reference for peer-to-peer communications. The value shown is the output prior to the accel/decel ramp and any corrections supplied by slip comp, PI, etc.

273 Drive Ramp Rslt

Range: 0 to 32767 [1]
Default: Read Only
Access: 2 **Path:** Communication>Comm Control
See also:

Present frequency reference scaled as a DPI reference for peer-to-peer communications. The value shown is the value after the accel/decel ramp but prior to any corrections supplied by slip comp, PI, etc.

286 Manual Mask

Range: See figure 11.32
Default: 0x2F
Access: 2 **Path:** Communication>Masks & Owners
See also:

Disables manual mode activation from the port corresponding to bit number.

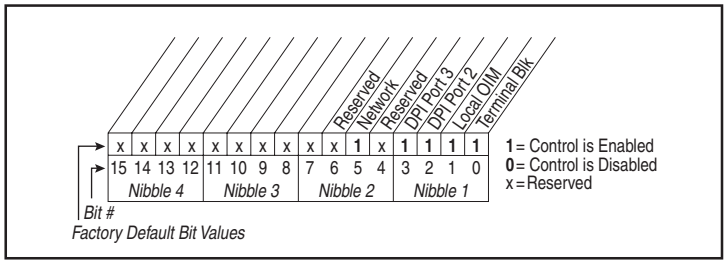


Figure 11.32 – Manual Mask (286)

Example:

Bit 0 = 0 Terminal block disabled
Bit 1 = 1 Local OIM enabled

In this example, manual mode can be selected by the OIM but not by terminal block inputs.

288 Stop Owner

Range: See figure 11.33
Default: Read Only
Access: 2 **Path:** Communication>Masks & Owners
See also: 276 - 285

Inputs that are presently issuing a valid stop command.

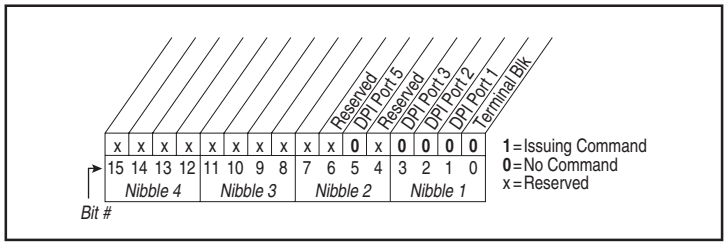


Figure 11.33 – Stop Owner

Source	Location
Terminal Block	Logic I/O
DPI Port 1	Local OIM
DPI Port 2	DIN port at base of drive
DPI Port 3	Split DIN port
DPI Port 5 (Network)	Network option

298 Manual Owner

Range: See figure 11.34
Default: Read Only
Access: 2 **Path:** Communication>Masks & Owners
See also:

Indicates the source providing manual control and reference.

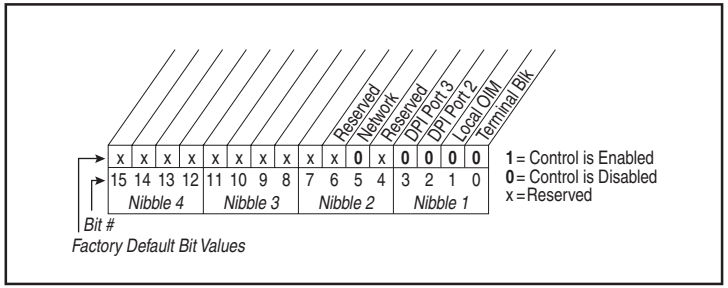


Figure 11.34 – Manual Owner

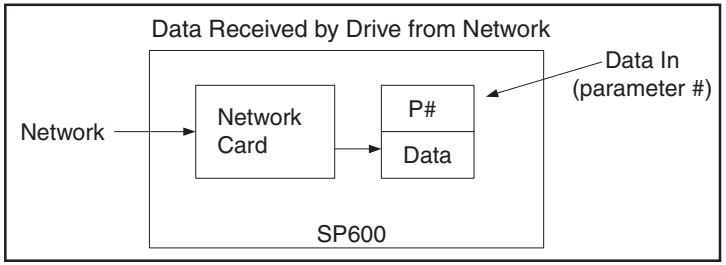
300 **Data In A1** - Link A Word 1
301 **Data In A2** - Link A Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written from a network communications device data table.

Parameters that can only be changed while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications option board manual for Datalink information.



302 **Data In B1** - Link B Word 1
303 **Data In B2** - Link B Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written from a communications device data table.

Parameters that can only be changed while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications option board manual for Datalink information.

304 **Data In C1** - Link C Word 1
305 **Data In C2** - Link C Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written from a network communications device data table.

Parameters that can only be changed while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications option board manual for Datalink information.

306 **Data In D1** - Link D Word 1
307 **Data In D2** - Link D Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written from a network communications device data table.

Parameters that can only be changed while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications option board manual for Datalink information.

310 **Data Out A1**- Link A Word 1
311 **Data Out A2** - Link A Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written to a communications device data table.

312 **Data Out B1**- Link B Word 1
313 **Data Out B2** - Link B Word 2

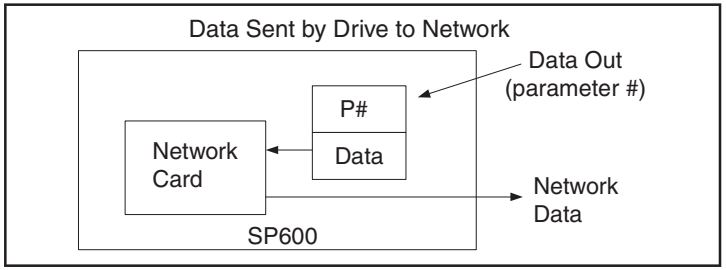
Range: 0 to 387 [1]

Default: 0 (Disabled)

Access: 2 **Path:** Communication>Datalinks

See also:

Parameter number whose value will be written to a network communications device data table.



314 **Data Out C1**- Link C Word 1
315 **Data Out C2** - Link C Word 2

Range: 0 to 387 [1]

Default: 0 (Disabled)

Access: 2 **Path:** Communication>Datalinks

See also:

Parameter number whose value will be written to a network communications device data table.

316 **Data Out D1**- Link D Word 1
317 **Data Out D2** - Link D Word 2

Range: 0 to 387 [1]

Default: 0 (Disabled)

Access: 2 **Path:** Communication>Datalinks

See also:

Parameter number whose value will be written to a network communications device data table.

320 Anlg In Config

Range: See figure 11.35
Default: See figure 11.35
Access: 0 **Path:** Inputs & Outputs>Analog Inputs
See also: 322, 323, 325, 326

Selects the type of input signal being used for analog input 1 and 2. These inputs can be configured as 0 to 10 VDC or 4 to 20 mA inputs.

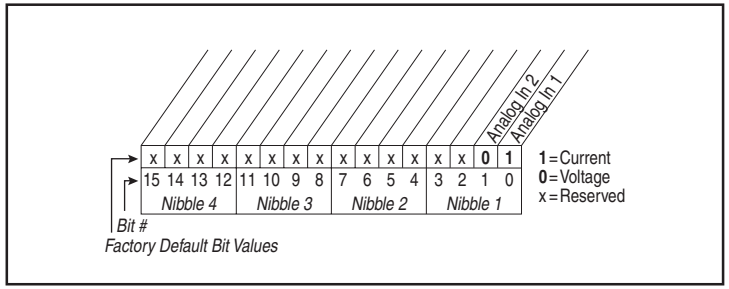


Figure 11.35 – Anlg In Config (320)

321 Anlg In Sqr Root

Range: See figure 11.36
Default: See figure 11.36
Access: 2 **Path:** Inputs & Outputs>Analog Inputs
See also:

Enables/disables the square root function for each analog input.

This function should be enabled if the input signal being monitored varies with the square of the quantity. The square root function is scaled such that the input range is the same as the output range. For example, if the input is set up as a unipolar voltage input, then the input and output ranges of the square root function will be 0 to 10 volts.

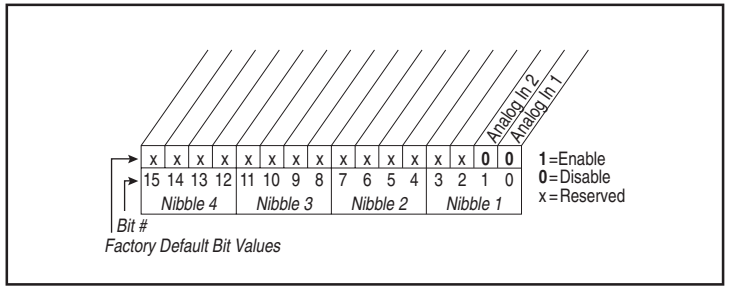


Figure 11.36 – Anlg In Sqr Root (321)

322 Analog In 1 Hi

Range:	4.000 to 20.000 mA [0.001 mA] -/+10.0 V [0.1 V] 0.0 to 10.0 V [0.1 V]
Default:	20.000 mA
Access:	0 **Path:** Inputs & Outputs>Analog Inputs
See also:	91, 92, 320

The drive scales the value read from the analog input and converts it to units usable for the application. The user controls the scaling by setting parameters that associate a low and high point in the input range with a low and high point in the target range.

Analog In 1 Hi sets the highest input value to the analog input 1 scaling block.

Analog Input Scaling Example

Speed Ref A Sel = Analog In 1

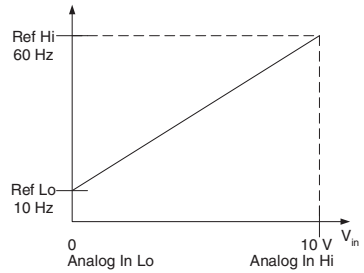
Ref. Lo (92) = 10 Hz

Ref. Hi (91) = 60 Hz

Analog In 1 Lo (323) = 0.0 V

Analog In 1 Hi (322) = 10.0 V

This is the default setting, where minimum input (0 V) represents Ref. Lo and maximum input (10 V) represents Ref. Hi.



323 Analog In 1 Lo

Range:	4.000 to 20.000 mA [0.001 mA] -/+10.0 V [0.1 V] 0.0 to 10.0 V [0.1 V]
Default:	4.000 mA
Access:	0 **Path:** Inputs & Outputs>Analog Inputs
See also:	91, 92, 320

Sets the lowest input value to the analog input 1 scaling block. Refer to Analog In 1 Hi (322) for more information.

324 Analog In 1 Loss

Range:	0 = Disabled 1 = Fault 2 = Hold Input (use last frequency command) 3 = Set Input Lo (use Minimum Speed as frequency command) 4 = Set Input Hi (use Maximum Speed as frequency command) 5 = Goto Preset1 (use Preset 1 as frequency command) 6 = Hold OutFreq (maintain last output frequency)
Default:	0 = Disabled
Access:	2 **Path:** Inputs & Outputs>Analog Inputs
See also:	91, 92

Selects drive response when an analog signal loss is detected. (1.6V = signal loss, 1.9V = end of signal loss; 3.2 mA = signal loss, 3.8 mA = end of signal loss.)

One of the selections (1=Fault) stops the drive on signal loss. All other choices make it possible for the input signal to return to a usable level while the drive is still running.

ATTENTION: Setting parameter 324 to a value other than 1 allows the drive to continue running or resume running if a signal loss occurs. If a lost analog signal is restored while the drive is running, the drive will ramp to the restored reference level at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142), and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Important: Note that there is no signal loss detection while the input is in bipolar voltage mode.

325 Analog In 2 Hi

Range:	4.000 to 20.000 mA [0.001 mA] -/+10.0 V [0.1 V] 0.0 to 10.0 V [0.1 V]
Default:	10 V
Access:	2 **Path:** Inputs & Outputs>Analog Inputs
See also:	91, 92, 320

Sets the highest input value to the analog input 2 scaling block. See parameter 322 for an example.

326 Analog In 2 Lo

Range: 4.000 to 20.000 mA [0.001 mA]
-/+10.0 V [0.1 V]
0.0 to 10.0 V [0.1 V]

Default: 0.000 V

Access: 2 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92, 320

Sets the lowest input value to the analog input 2 scaling block.

327 Analog In 2 Loss

Range:
0 = Disabled
1 = Fault
2 = Hold Input (use last frequency command)
3 = Set Input Lo (use Minimum Speed as frequency command)
4 = Set Input Hi (use Maximum Speed as frequency command)
5 = Goto Preset1 (use Preset1 as frequency command)
6 = Hold OutFreq (maintain last output frequency)

Default: 0 = Disabled

Access: 2 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92

Selects drive action when an analog signal loss is detected. (1.6V = signal loss, 1.9 = end of signal loss; 3.2 mA = signal loss, 3.8 mA = end of signal loss.)

One of the selections (1=Fault) stops the drive on signal loss. All other choices make it possible for the input signal to return to a usable level while the drive is still running.

ATTENTION: Setting parameter 327 to a value other than 1 allows the drive to continue running or resume running if a signal loss occurs. If a lost analog signal is restored while the drive is running, the drive will ramp to the restored reference level at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142), and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Important: Note that there is no signal loss detection while the input is in bipolar voltage mode.

340 Anlg Out Config

Range: See figure 11.37
Default: 0
Access: 1 **Path:** Inputs & Outputs>Analog Outputs
See also:

Selects the mode for the analog output.

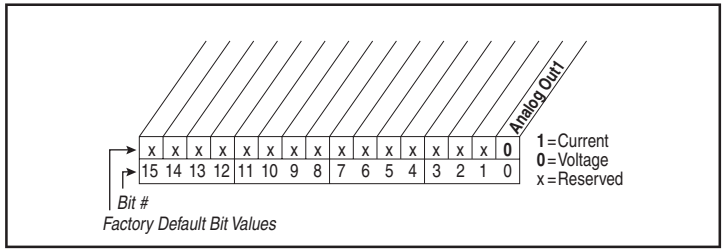


Figure 11.37 – Analog Out Config

341 Anlg Out Absolut

Range: See figure 11.38
Default: See figure 11.38
Access: 2 **Path:** Inputs & Outputs>Analog Outputs
See also: 342

Selects whether the signed value or absolute value of a parameter is used before being scaled to drive the analog output.

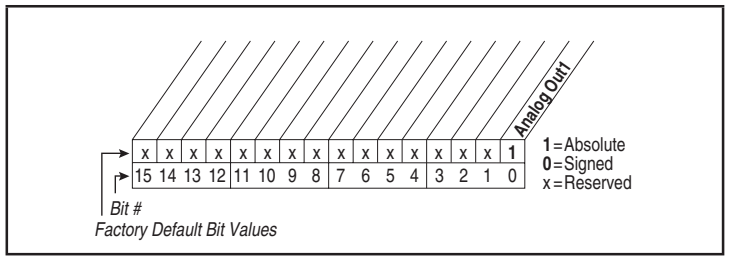


Figure 11.38 – Anlg Out Absolute (341)

Bit	Signal Level	Output Volts
0	-100%	0 V
	0%	5 V
	100%	10 V
1	-100%	10 V
	0%	0 V
	100%	10 V

342 Analog Out1 Sel

Range: 0 = Output Freq: Output frequency (see figure 7.3 - Speed Reference Control Flowchart)
1 = Command Freq: Commanded frequency setpoint (see figure 7.3 - Speed Reference Control Flowchart)
2 = Output Amps: Total output current
3 = Torque Amps: Torque current
4 = Flux Amps: Flux current
5 = Output Power: Output power
6 = Output Volts: Output voltage
7 = DC Bus Volts: DC Bus voltage
8 = PI Reference: PI setpoint value
9 = PI Feedback: PI feedback value
10 = PI Error: Difference between PI Reference & PI Feedback (reference - feedback)
11 = PI Output: PI output value
12 = % Motor OL: Motor overload percentage
13 = % Drive OL: Drive overload percentage
14 = Post Rmp Ref: Post Ramp Reference value (see figure 7.3 - Speed Reference Control Flowchart)

Default: 0 = Output Freq

Access: 1 **Path:** Inputs & Outputs>Analog Outputs

See also: 1 - 7, 12, 135 - 138, 219, 220

Selects the source of the value that drives the analog output. Refer to table 11.4.

343 Analog Out1 Hi

Range: ±10.000 V / 4 - 20 mA [0.001 V / .001 mA]

Default: 10.000 V / 20.000 mA

Access: 1 **Path:** Inputs & Outputs>Analog Outputs

See also: 342

Sets the analog output value when the source value is at maximum.

Scaling the Analog Output

The user defines the scaling for the analog output by entering analog output voltages into Analog Out1 Lo and Analog Out1 Hi. These two output voltages correspond to the bottom and top of the possible range covered by the quantity being output. The output voltage will vary linearly with the quantity being output. The analog output voltage will not go outside the limits defined by Analog Out1 Lo and Analog Out 1 Hi. See table 11.5.

Table 11.5 – Analog Output Scaling

Options:		Analog Out1 Lo (344) Value Corresponds to:		Analog Out1 Hi (343) Value Corresponds to:
		Analog Out Absolut (341) = Disabled	*Analog Out Absolut (341) = Enabled*	
0	Output Freq	–[Maximum Speed]	0 Hz	+[Maximum Speed]
1	Commanded Freq	–[Maximum Speed]	0 Hz	+[Maximum Speed]
2	Output Amps	0 Amps	0 Amps	200% Rated
3	Torque Amps	–200% Rated	0 Amps	200% Rated
4	Flux Amps	0 Amps	0 Amps	200% Rated
5	Output Power	0 kW	0 kW	200% Rated
6	Output Volts	0 Volts	0 Volts	120% Rated
7	DC Bus Volts	0 Volts	0 Volts	200% Rated
8	PI Reference	–100%	0%	100%
9	PI Feedback	–100%	0%	100%
10	PI Error	–100%	0%	100%
11	PI Output	–100%	0%	100%
12	%Motor OL	0%	0%	100%
13	%Drive OL	0%	0%	100%
14	Post Ramp Ref	–[Maximum Speed]	0 Hz	+[Maximum Speed]

344 Analog Out1 Lo

Range: ±10.000 V / 4 - 20 mA [0.001 V / .001 mA]

Default: 0.000 V / 4.000 mA

Access: 1 **Path:** Inputs & Outputs>Analog Outputs

See also: 342, 343

Sets the analog output value when the source value is at minimum.

Refer to Analog Out1 Hi (343) for more information.

361 Digital In1 Sel
362 Digital In2 Sel
363 Digital In3 Sel
364 Digital In4 Sel
365 Digital In5 Sel
366 Digital In6 Sel

Range: 0 = Not Used
1 = Enable
2 = Clear Faults[1]
3 = Function Loss
4 = Stop - CF[2]
5 = Start
6 = Fwd/Reverse[3]
7 = Run[4]
8 = Run Forward[4]
9 = Run Reverse[4]
10 = Jog[3]
11 = Jog Forward
12 = Jog Reverse
13 = Stop Mode B
14 = Bus Reg Md B
15 = Speed Sel 1[5]
16 = Speed Sel2[5]
17 = Speed Sel 3[5]
18 = Manual
19 = Reserved
20 = Acc2 & Dec2
21 = Accel 2
22 = Decel 2
23 = MOP Inc
24 = MOP Dec
25 = OIM Control
26 = PI Enable
27 = PI Hold
28 = PI Reset
29 = Pwr Loss Lvl
30 = Precharge En
31 - 38 = Reserved
39 = UserSetBit0
40 = UserSetBit1

Default: See table 11.7

Access: 1 **Path:** Inputs & Outputs>Digital Inputs

See also: 96, 100, 124, 140, 156, 162, 194, 380

[1]When Digital In"x" Sel is set to option 2 (Clear Faults), the stop key cannot be used to clear a fault condition.

[2]Stop -CF may be used for 2 wire functions. See #4 below.

[3] Typical 3-Wire Inputs. These require that only 3-wire functions are chosen. Including 2-Wire selections will cause a type 2 alarm.

[4]Typical 2-Wire Inputs. These require that only 2-wire functions are chosen. Including 3-wire selections will cause a type 2 alarm.

[5]To access Preset Speed 1, set Speed Ref A Sel to Preset Speed 1. See table 11.3.

Table 11.6 – Speed Select Inputs

Speed Select Inputs			
3	2	1	Reference Source
0	0	0	Speed Ref A Sel (90)
0	0	1	Preset Speed 1 (101)
0	1	0	Preset Speed 2 (102)
0	1	1	Preset Speed 3 (103)
1	0	0	Preset Speed 4 (104)
1	0	1	Preset Speed 5 (105)
1	1	0	Preset Speed 6 (106)
1	1	1	Preset Speed 7 (107)

Assigns an input function to the drive's digital inputs.

Table 11.7 – Default Values for Parameters 361-366

Parameter No.	Default Value
361	4 = Stop - CF
362	5 = Start
363	3 = Function Loss
364	10 = Jog
365	18 = Auto/Man
366	15 = Speed Sel 1

1 = Enable: If the input is closed, the drive can run (start permissive). If the input is open, the drive will not start.

If the drive is already running when this input is opened, the drive will coast and indicate "not enabled" on the OIM (if present). This is not considered a fault condition, and no fault will be generated.

If multiple enable inputs are configured, the drive will not run if any of them are open.

2 = Clear Faults: This function allows an external device to reset drive faults through the terminal block if Logic Source Sel (89) is set to Terminal Blk or All Ports. An open-to-closed transition on this input will reset the current fault (if any).

If this input is configured at the same time as Stop-Clear Faults, then only the Clear Faults input can actually cause faults to be reset.

3 = Function Loss: If the function loss input is open, a fault is generated. The function loss input is active at all times regardless of the selected logic control source.

Important: The function loss input is not intended for a fast output power kill. The drive will not fault until the software detects the change of state of this input. If this input function is not configured, the fault will not occur.

4 = Stop - CF (Stop - Clear Faults): An open input will assert a stop command if the terminal block is the control source. While the stop is asserted, the drive ready status will be off. A closed input will allow the drive to start. An open-to-closed transition is interpreted as a clear faults request. The drive will clear any existing faults.

If Start is configured, then Stop-Clear Faults must also be configured to prevent a digital input configuration alarm condition. Stop-Clear Faults is optional in all other circumstances.

5 = Start: An open-to-closed transition generates a run command if the terminal block is the control source.

If Start is configured, then Stop-Clear Faults must also be configured to prevent a digital input configuration alarm condition.

6 = Fwd/Reverse (Forward/Reverse): An open input sets the direction to forward if the terminal block is the control source. A closed input sets the direction to reverse. If the state of the input changes and the drive is running or jogging, the drive will change direction.

If the Fwd/Rev input function is assigned to more than one physical digital input at a time, a digital input configuration alarm will be asserted.

7 = Run: An open-to-closed transition on this input generates a a run command if the terminal block is the control source. If the input is open, the drive will stop.

The purpose of this input function is to allow a 2-wire start while the direction is being controlled by some other function.

8 and **9 = Run Forward** and **Run Reverse:** If the terminal block is the control source, an open-to-closed transition on one or both inputs while the drive is stopped will cause the drive to run unless the Stop - Clear Faults input function is configured and open. See 4, above.

If one or both of these input functions are assigned to more than one physical digital input at a time, a digital input configuration alarm will be asserted.

10 = Jog: An open-to-closed transition on this input while the drive is stopped causes the drive to start (jog) in the current direction. When the input opens while the drive is running (jogging), the drive will stop.

ATTENTION: If a normal drive start command is received while the drive is jogging, the drive will switch from jog mode to run mode. The drive will not stop, but may change speed and/or change direction. Failure to observe this precaution could result in severe bodily injury or loss of life.

The drive will not jog while running or while the Stop - Clear Faults input is open. Start has precedence over jog.

11 and **12** = **Jog Forward** and **Jog Reverse:** An open-to-closed transition on one or both inputs while the drive is stopped will cause the drive to jog unless the Stop - Clear Faults input function is configured and open. Table 11.8 describes the actions taken by the drive in response to various states of these input functions.

Table 11.8 – Drive Response to Jog Forward and Jog Reverse Inputs

Jog Forward	Jog Reverse	Drive Response
Open	Open	Drive will stop if already jogging, but can be started by other means.
Open	Closed	Drive jogs in reverse direction.
Closed	Open	Drive jogs in forward direction.
Closed	Closed	Drive continues to jog in current direction.

ATTENTION: If a normal drive start command is received while the drive is jogging, the drive will switch from jog mode to run mode. The drive will not stop, but may change speed and/or change direction. Failure to observe this precaution could result in severe bodily injury or loss of life.

The drive will not jog while running or while the Stop - Clear Faults input is open. Start has precedence over jog.

If one of these input functions is configured and the other one is not, table 11.8 still applies, but the unconfigured input function should be considered permanently open.

13 = Stop Mode B: This digital input selects between two different drive stop modes.

If the input is open, then Stop Mode A selects which stop mode to use. If the input is closed, the Stop Mode B selects which stop mode to use. If this input function is not configured, then Stop Mode A selects which stop mode to use.

14 = Bus Regulation Mode B: This digital input function selects how the drive will regulate excess voltage on the DC bus.

If the input is open, then Bus Reg Mode A selects which bus regulation mode to use. If the input is closed, then Bus Reg Mode B selects which bus regulation mode to use. If this input function is not configured, then Bus Reg Mode A selects which bus regulation mode to use.

15-17 = Speed Select 1, 2, 3: One, two, or three digital input functions can be used to select the speed reference used by the drive, and they are called the Speed Select input functions. The current open/closed state of all Speed Select input functions combine to select which source is the current speed reference.

There are 7 possible combinations of open/closed states for the three input functions, and thus 7 possible parameters can be selected. The 7 parameters are: Speed Ref A Sel and Preset Speed 2 through Preset Speed 7.

If the Speed Select input functions select Speed Ref A Sel , then the value of that parameter further selects a reference source. There are a large number of possible selections, including all 6 presets.

If the input functions directly select one of the preset speed parameters, then the parameter contains a frequency that is to be used as the reference.

The Speed Select input function configuration process involves assigning the functionality of the three possible Speed Select input functions to physical digital inputs. The three Speed Select inputs functions are called Speed Select 1, Speed Select 2, and Speed Select 3, and they are assigned to physical inputs using the Digital In”x” Sel parameters.

Table 11.9 describes the various reference sources that can be selected using all three of the Speed Select input functions. If any of the three Reference Select input functions are not configured, then the software will still follow the table, but will treat the unconfigured inputs as if they are permanently open.

Table 11.9 – Effect of Speed Select Input State on Selected Reference

Speed Select 3	Speed Select 2	Speed Select 1	Parameter that determines reference:
Open	Open	Open	Speed Ref A Sel
Open	Open	Closed	Preset Speed 1
Open	Closed	Open	Preset Speed 2
Open	Closed	Closed	Preset Speed 3
Closed	Open	Open	Preset Speed 4
Closed	Open	Closed	Preset Speed 5
Closed	Closed	Open	Preset Speed 6
Closed	Closed	Closed	Preset Speed 7

18 = Manual: The Manual function allows a single control device to assume exclusive control of the manual reference. The most recent peripheral (OIM or terminal block) that makes a manual reference request will be given control of the manual reference setpoint.

If the Manual input function is closed, then the drive will use one of the analog inputs (defined by TB Man Ref Sel) as the reference. If an OIM subsequently requests manual control (that is, Auto/Man F-Key is pressed) and then gives control up (presses Auto/Man F-Key again), then the Auto/Manual digital input must be opened and closed again to regain control of the manual reference.

If this input is open, then the terminal block does not request manual control of the reference. If no control device (including the terminal block) is current requesting manual control of the reference, then the drive will use the normal reference selection mechanisms.

19 = Reserved

20 = Acc2 & Dec2: A single input function is used to select between Accel Time 1/Decel Time 1 and Accel Time 2/Decel Time2.

If the function is open, the drive will use Accel Time 1 as the acceleration rate and Decel Time 1 as the deceleration rate. If the function is closed, the drive will use Accel Time 2 as the acceleration rate and Decel Time 2 as the deceleration rate.

21, 22 = Accel 2, Decel 2: One input function (called Accel 2) selects between Accel Time 1 and Accel Time 2, and another input function (called Decel 2) selects between Decel Time 1 and Decel Time 2. The open state of the function selects Accel Time 1 or Decel Time 1, and the closed state selects Accel Time 2 or Decel Time 2.

23, 24 = MOP Increment, MOP Decrement: The MOP is a reference setpoint (called the MOP Value) that can be incremented and decremented by external devices. These inputs are used to increment and decrement the Motor Operated Potentiometer (MOP) value inside the drive. The MOP value will be retained through a power cycle.

While the MOP Increment input is closed, the MOP value will increase at rate contained in MOP Rate. Units for rate are Hz per second.

While the MOP Decrement input is closed, MOP value will decrease at rate contained in MOP Rate. Units for rate are Hz per second.

If both the MOP Increment and MOP Decrement inputs are closed, the MOP value will stay the same.

In order for the drive to use the MOP value as the current speed reference, either Speed Ref A Sel must be set to MOP.

25 = OIM Control: This input provides a mean to override the logic control source selection and can be used to override control from any port, including the All Ports selection.

An open-to-closed transition of this input sets the control source to the local OIM. If no local OIM is present, the control source is set to the remote OIM. If no OIM is present at all, the drive stops.

When control is set to the OIM, the OIM is granted manual reference (the Man Ref Preload (193) configuration is enforced). Subsequent Auto/Manual commands will toggle the OIM in and out of manual mode. The drive's active or stopped state is not affected unless no OIM is present.

On a closed-to-open transition, manual control is released if active, and the selected auto reference is used. The logic source select override is removed. The edge/level-sense start configuration is imposed (LevelSense Start).

26 = PI Enable: If this input function is closed, the operation of the Process PI loop will be enabled.

If this input function is open, the operation of the Process PI loop will be disabled.

27 = PI Hold: If this input function is closed, the integrator for the Process PI loop will be held at the current value; that is, it will not increase.

If this input function is open, the integrator for the Process PI loop will be allowed to increase.

28 = PI Reset: If this input function is closed, the integrator for the Process PI loop will be reset to 0.

If this input function is open, the integrator for the Process PI loop will integrate normally.

29 = Pwr Loss Lvl: When the DC bus level in the drive falls below a certain level, a “powerloss” condition is created in the drive logic. This input allows the user to select between two different “power loss” detection levels dynamically. If the physical input is closed, then the drive will take its power loss level from a parameter. If the physical input is open (de-energized), then the drive will use a power loss level designated by internal drive memory, typically 82% of nominal. If the input function is not configured, then the drive always uses the internal power loss level.

30 = Prechange En: This input function is used to manage disconnection from a common DC bus.

If the physical input is closed, this indicates that the drive is connected to common DC bus and normal precharge handling can occur, and that the drive can run (start permissive). If the physical input is open, this indicates that the drive is disconnected from the common DC bus, and thus the drive should enter the precharge state (precharge relay open) and initiate a coast stop immediately in order to prepare for reconnection to the bus.

If this input function is not configured, then the drive assumes that it is always connected to the DC bus, and no special precharge handling will be done.

31 - 38 = Reserved

39 = UserSetBit0: 0 = Disabled; 1 = Enabled

40 = UserSetBit1: 0 = Disabled; 1 = Enabled

UserSetBit1	UserSetBit0	UserSet Loaded in Memory
0	0	User Set 1
0	1	User Set 2
1	0	User Set 3
1	1	User Set 3

If either UserSetBit# is not defined, a zero value is used.

Type 2 Alarms

Some digital input programming may cause conflicts that result in a Type 2 alarm. For example, Digital In1 Sel set to 5 (Start) in 3-wire control, and Digital In2 Sel set to 7 (Run) in 2-wire control. Refer to chapter 12 for more information about these alarms. Note that Type 2 alarms will prevent the drive from starting.

Dig In Status (116) indicates the current state of the digital inputs.

380 Digital Out1 Sel

Range:
1 = Fault[1] - A fault has occurred and stopped the drive
2 = Alarm[1] - A Type 1 or Type 2 alarm condition exists
3 = Ready - The drive is powered, Enabled and no start inhibits exist. It is “ready” to run
4 = Run - The drive is outputting voltage and frequency to the motor (indicates 3–wire control, either direction)
5 = Forward Run - The drive is outputting voltage and frequency to the motor (indicates 2–wire control in forward)
6 = Reverse Run - The drive is outputting voltage and frequency to the motor (indicates 2–wire control in reverse)
7 = Auto Restart - The drive is currently executing the Auto Restart or “Run at Power Up” function
8 = Reserved
9 = At Speed - The output frequence equals the commanded speed
10 = At Freq[2] - The drive output frequency equals or exceeds the programmed limit
11 = At Current[2] - The drive total output current exceeds the programmed limit
12 = At Torque[2] - The drive output torque current component exceeds the programmed limit
13 = At Temp[2] - The drive operating temperature exceeds the programmed limit
14 = At Bus Volts[2] - The drive bus voltage exceeds the programmed limit
15 = At PI Error[2] - The drive Process PI Loop error exceeds the programmed limit
16 = DC Braking - The drive is currently executing either a “DC Brake” or a “Ramp to Hold” stop command and the DC braking voltage is still being applied to the motor.
17 = Curr Limit - The drive is currently limiting output current
18 = Economize - The drive is currently reducing the output voltage to the motor to attempt to reduce energy costs during a lightly loaded situation.
19 = Motor Overld - The drive is currently reducing the output voltage to the motor to attempt to reduce energy costs during a lightly loaded situation.
20 = Power Loss - The drive has monitored DC bus voltage and sensed a loss of input AC power that caused the DC bus voltage to fall below the fixed monitoring value (82% of DC bus Memory (13))
21 = Input 1 Link - The digital input value is output on Dig Out1
22 = Input 2 Link
23 = Input 3 Link
24 = Input 4 Link
25 = Input 5 Link
26 = Input 6 Link
27 = TB in Manual - The terminal block has manual reference control

Default: 1 = Fault

Access: 1 **Path:** Inputs & Output>Digital Outputs

380 Digital Out1 Sel

See also: 1-4, 12, 48, 53, 137, 147, 157, 184, 218, 381-383, 385, 386

[1]Any relay programmed as fault or alarm will energize (pick up) when power is applied to the drive and de-energize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will de-energize when the condition is removed.

[2]Activation level is defined in Dig Out "x" level (381, 385).

Selects the drive signal that will energize an output relay.

381 Dig Out1 Level

Range: 0.0 to 819.2 [0.1]

Default: 0.0

Access: 1 **Path:** Inputs & Outputs>Digital Outputs

See also: 380

Sets the relay activation level for options 10-15 in Digital Out1 Sel (380). Units are assumed to match the above selection (i.e., At Freq = Hz, At Torque = Amps).

382 Dig Out1 OnTime

Range: 0.00 to 600.00 Sec [0.01 Sec]

Default: 0.00 Sec

Access: 2 **Path:** Inputs & Outputs>Digital Outputs

See also: 380

Sets the on delay time for the digital outputs. This is the time between the occurrence of a condition and activation of the relay.

383 Dig Out2 OffTime

Range: 0.00 to 600.00 Sec [0.01 Sec]

Default: 0.00 Sec

Access: 2 **Path:** Inputs & Outputs>Digital Outputs

See also: 380

Sets the off delay time for the digital outputs. This is the time between the disappearance of a condition and de-activation of the relay.

384 Digital Out1 Sel

Range:
1 = Fault[1] - A fault has occurred and stopped the drive
2 = Alarm[1] - A Type 1 or Type 2 alarm condition exists
3 = Ready - The drive is powered, Enabled and no start inhibits exist. It is “ready” to run
4 = Run - The drive is outputting voltage and frequency to the motor (indicates 3–wire control, either direction)
5 = Forward Run - The drive is outputting voltage and frequency to the motor (indicates 2–wire control in forward)
6 = Reverse Run - The drive is outputting voltage and frequency to the motor (indicates 2–wire control in reverse)
7 = Auto Restart - The drive is currently executing the Auto Restart or “Run at Power Up” function
8 = Reserved
9 = At Speed - The output frequence equals the commanded speed
10 = At Freq[2] - The drive output frequency equals or exceeds the programmed limit
11 = At Current[2] - The drive total output current exceeds the programmed limit
12 = At Torque[2] - The drive output torque current component exceeds the programmed limit
13 = At Temp[2] - The drive operating temperature exceeds the programmed limit
14 = At Bus Volts[2] - The drive bus voltage exceeds the programmed limit
15 = At PI Error[2] - The drive Process PI Loop error exceeds the programmed limit
16 = DC Braking - The drive is currently executing either a “DC Brake” or a “Ramp to Hold” stop command and the DC braking voltage is still being applied to the motor.
17 = Curr Limit - The drive is currently limiting output current
18 = Economize - The drive is currently reducing the output voltage to the motor to attempt to reduce energy costs during a lightly loaded situation.
19 = Motor Overld - The drive is currently reducing the output voltage to the motor to attempt to reduce energy costs during a lightly loaded situation.
20 = Power Loss - The drive has monitored DC bus voltage and sensed a loss of input AC power that caused the DC bus voltage to fall below the fixed monitoring value (82% of DC bus Memory (13))
21 = Input 1 Link - The digital input value is output on Dig Out1
22 = Input 2 Link
23 = Input 3 Link
24 = Input 4 Link
25 = Input 5 Link
26 = Input 6 Link
27 = TB in Manual - The terminal block has manual reference control

Default: 4 = Run

Access: 1 **Path:** Inputs & Output>Digital Outputs

384 Digital Out1 Sel

See also: 1-4, 12, 48, 53, 137, 147, 157, 184, 218, 381-383, 385, 386

[1]Any relay programmed as fault or alarm will energize (pick up) when power is applied to the drive and de-energize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will de-energize when the condition is removed.

[2]Activation level is defined in Dig Out "x" level (381, 385).

Selects the drive status that will energize an output relay.

385 Dig Out2 Level

Range: 0.0 to 819.2 [0.1]

Default: 0.0

Access: 1 **Path:** Inputs & Output>Digital Outputs

See also: 380

Sets the relay activation level for options 10-15 in Digital Out2 Sel (384). Units are assumed to match the above selection (i.e., At Freq = Hz, At Torque = Amps).

386 Dig Out2 OnTime

Range: 0.00 to 600.00 Sec [0.01 Sec]

Default: 0.00 Sec

Access: 2 **Path:** Inputs & Output>Digital Outputs

See also: 380

Sets the on delay time for the digital outputs. This is the time between the occurrence of a condition and activation of the relay.

387 Dig Out2 OffTime

Range: 0.00 to 600.00 Sec [0.01 Sec]

Default: 0.00 Sec

Access: 2 **Path:** Inputs & Output>Digital Outputs

See also: 380

Sets the off delay time for the digital outputs. This is the time between the disappearance of a condition and de-activation of the relay.

CHAPTER 12

Troubleshooting the Drive

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

The SP600 drive provides the following ways to determine the status of the drive and to troubleshoot problems that may occur:

- Ready LED on the drive cover
- User-configurable and non-configurable alarms
- User-configurable and non-configurable faults
- Entries in the fault queue
- Drive status parameters

12.1 Verifying that DC Bus Capacitors are Discharged Before Servicing the Drive

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five (5) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

The drive's DC bus capacitors retain hazardous voltages after input power has been disconnected. Perform the following steps before touching any internal components.

Step 1. Turn off and lock out input power. Wait 5 minutes.

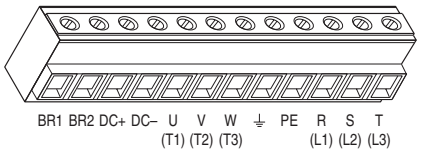
Step 2. Open the drive's cover.

Step 3. Verify that there is no voltage at the drive's input power terminals.

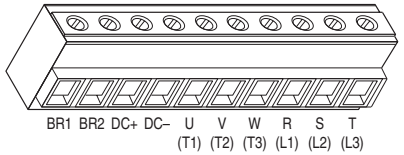
Step 4. Measure the DC bus potential with a voltmeter while standing on a non-conductive surface and wearing insulated gloves. Refer to figure 12.1.

Step 5. Once the drive has been serviced, reattach the drive's cover.

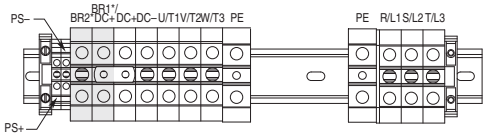
Step 6. Reapply input power.



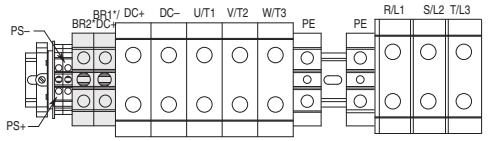
Frame 2



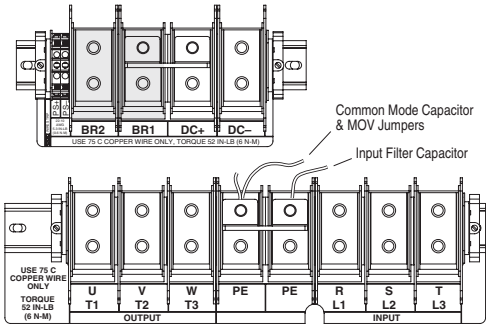
Frames 3 & 4



Frame 5 (75 HP)



Frame 5 (100 HP)



Frame 6 (125, 150, 200 HP)

Refer to table 6.4 for terminal descriptions.

Figure 12.1 – Location of DC Bus Voltage Measuring Points

12.2 Determining Precharge Board Status Using the LED Indicators (Frames 5 & 6 Only)

The precharge board LEDs are located above the Line Type jumper shown in figure 12.2.

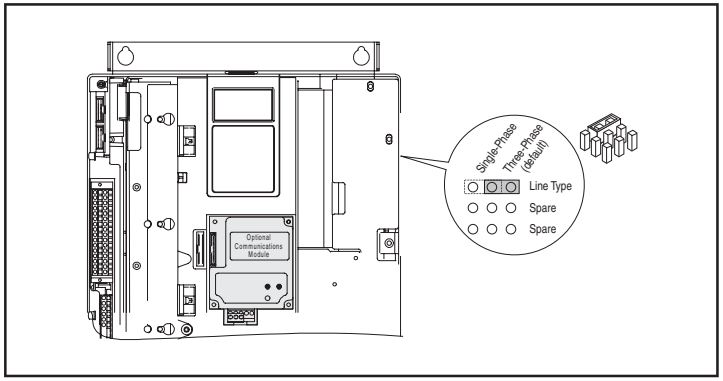


Figure 12.2 – Location of Precharge Status LED

Table 12.1 – Precharge Board LED Indicators

Name	Color	State	Description
Power ON	Green	Steady	Indicates when pre-charge board power supply is operational
Alarm	Yellow	Steady	Indicates one of the following alarms occurred causing the pre-charge to momentarily stop firing: • Line Loss • Low Phase (single-phase dropped below 80% of line voltage) • Input frequency out of range (momentarily) **Note**: An alarm condition automatically resets when the condition no longer exists
Fault	Red	Steady	Indicates one of the following faults: • DC Bus short • DC Bus not charged • Input frequency out of range • Overtemperature **Note**: A fault indicates a malfunction that needs to be corrected prior to restarting. A fault condition is only reset after cycling power.

12.3 Determining Drive Status Using the Ready LED

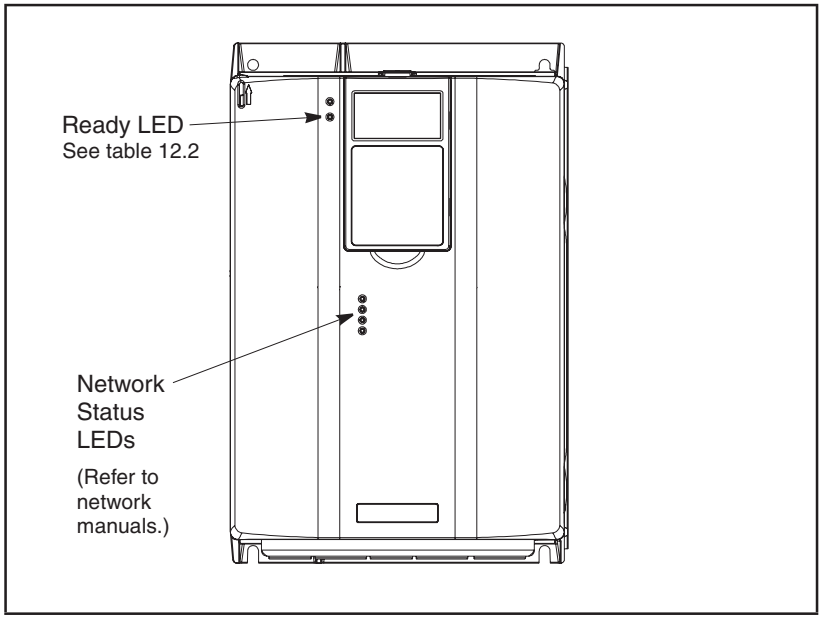


Figure 12.3 – Location of the Ready LED

Table 12.2 – Ready LED Status Definitions

Color	State	Description
Green	Flashing	Drive ready, but not running and no faults are present.
	Steady	Drive running, no faults are present.
Yellow See section 12.4.	Flashing	The drive is not ready. Check parameter 214 (Start Inhibits).
	Steady	An alarm condition exists. Check parameters 211 (Drive Alarm 1) and 212 (Drive Alarm 2).
Red See section 12.5.	Flashing	A fault has occurred.
	Steady	A non-resettable fault has occurred.

12.4 About Alarms

Alarms indicate conditions that may affect drive operation or application performance.

There are two alarm types, as described in table 12.3.

Table 12.3 – Types of Alarms

Type	Alarm Description	
①	User-Configurable	These alarms alert the operator of conditions that, if left untreated, may lead to a fault condition. The drive continues to operate during the alarm condition. The alarms are enabled or disabled using Alarm Config 1 (259). The status of these alarms is shown in Drive Alarm 1 (211).
②	Non-Configurable	These alarms alert the operator of conditions caused by improper programming and prevent the drive from starting until the problem is resolved. These alarms are always enabled. The status of these alarms is shown in Drive Alarm 2 (212).

The drive indicates alarm conditions in the following ways:

- Ready LED on the drive cover (see table 12.2).
- Alarm name and bell graphic on the LCD OIM (see Appendix B). The alarm is displayed as long as the condition exists. The drive automatically clears the alarm when the condition causing it is removed.
- Alarm status parameters. Two 16-bit parameters, Drive Alarm 1 (211) and Drive Alarm 2 (212), indicate the status of type 1 and type 2 alarms, respectively. Refer to chapter 11 for the parameter descriptions.

12.4.1 About the Alarm Queue

The drive automatically retains a history of alarms that have occurred in the alarm queue. The alarm queue is accessed using the OIM or PC software.

The alarm queue holds the eight most recent alarms. The last alarm to occur is indicated in queue entry #1. As new alarms are logged into the queue, existing alarm entries are shifted (for example, entry #1 will move to entry #2). Once the queue is full, older alarms are discarded from the queue as new alarms occur.

All entries in the alarm queue are retained if power is lost. Alarms are automatically cleared when the alarm condition goes away.

The alarm queue can be cleared using the OIM by selecting “Clr Alarm Queue”, or by using a PC software tool.

12.4.2 Alarm Descriptions

Table 12.4 – Alarm Descriptions

<table>
<tr><th>Alarm</th><th>Type</th><th>Description</th></tr>
<tr><td>Analog In Loss</td><td>①</td><td>An analog input is configured for alarm on signal loss and signal loss has occurred.</td></tr>
<tr><td>Bipolar Conflict</td><td>②</td><td>Parameter 190 (Direction Mode) is set to Bipolar or Reverse Dis and one of more of the following digital input functions is configured: Fwd/Rev or Run Fwd. Note that the default is Reverse Dis.</td></tr>
<tr><td>Decel Inhibit</td><td></td><td>The drive is being inhibited from decelerating.</td></tr>
<tr><td>Dig In ConflictA</td><td>②</td><td>Digital input functions are in conflict. Combinations marked with a ▟ will cause an alarm.
<table>
<tr><th></th><th>Acc2 / Dec2</th><th>Accel 2</th><th>Decel 2</th><th>Fwd / Rev</th></tr>
<tr><td>Acc2 / Dec2</td><td></td><td>▟</td><td>▟</td><td></td></tr>
<tr><td>Accel 2</td><td>▟</td><td></td><td></td><td></td></tr>
<tr><td>Decel 2</td><td>▟</td><td></td><td></td><td></td></tr>
<tr><td>Fwd / Rev</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Dig In ConflictB</td><td>②</td><td>Digital input functions are in conflict. Combinations marked with a ▟ will cause an alarm.
<table>
<tr><th></th><th>Start</th><th>Stop–CF</th><th>Run</th><th>Run Fwd</th><th>Fwd/Rev</th></tr>
<tr><td>Start</td><td></td><td></td><td>▟</td><td>▟</td><td></td></tr>
<tr><td>Stop–CF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Run</td><td>▟</td><td></td><td></td><td>▟</td><td></td></tr>
<tr><td>Run Fwd</td><td>▟</td><td></td><td>▟</td><td></td><td>▟</td></tr>
<tr><td>Fwd / Rev</td><td></td><td></td><td></td><td>▟</td><td></td></tr>
</table></td></tr>
<tr><td>Dig In ConflictC</td><td>②</td><td>More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions:
<table>
<tr><td>Forward/Reverse</td><td>Run</td><td>Bus Regulation Mode B</td><td>Jog Reverse</td></tr>
<tr><td>Speed Select 1</td><td>Stop Mode B</td><td>Acc2 / Dec2</td><td>UserSetBit0</td></tr>
<tr><td>Speed Select 2</td><td>OIM Control</td><td>Accel 2</td><td>UserSetBit1</td></tr>
<tr><td>Speed Select 3</td><td>Stop Mode B</td><td>Decel 2</td><td></td></tr>
<tr><td>Run Forward</td><td>Run Reverse</td><td>Jog Speed</td><td></td></tr>
</table></td></tr>
<tr><td>DigIn Bad Value</td><td>②</td><td>Unsupported function selected in Digital In”x” Sel parameters (361-366).</td></tr>
</table>

Table 12.4 – Alarm Descriptions (Continued)

Alarm	Type	Description
Drive OL Level 1	①	The calculated IGBT temperature requires a reduction in PWM carrier frequency. If Drive OL Mode (150) is disabled and the load is not reduced, an overload fault will eventually occur.
Drive OL Level 2	①	The calculated IGBT temperature requires a reduction in Current Limit. If Drive OL Mode (150) is disabled and the load is not reduced, an overload fault will eventually occur.
Flux Amps Ref Rang	②	Result of autotune procedure (61).
IntDBRes OvrHeat	①	The drive has temporarily disabled the dynamic braking regulator because the resistor temperature has exceeded a predetermined value.
IR Volts Range	②	The drive autotuning default is Calculate and the value calculated for IR Drop Volts is not in the range of acceptable values. This alarm should clear when all motor nameplate data is properly entered.
Ixo Vlt Rang		Motor leakage inductance is out of range.
MaxFreq Conflict	②	The sum of Maximum Speed (82) and Overspeed Limit (83) exceeds Maximum Freq (55). Raise Maximum Freq (55) or lower Maximum Speed (82) and/or Overspeed Limit (83) so that the sum is less than or equal to Maximum Freq (55).
Motor Type Cflct	②	Motor Type (40) has been set to Sync Prm Mag or Sync Reluc, and one or more DC functions (for example, DC Boost, DC Brake, etc.) have been activated. DC injection functions are incompatible with synchronous motors and may demagnetize them.
NP Hz Conflict	②	Fan/pump mode is selected in Torq Perf Mode (53), and the ratio of Motor NP Hertz (43) to Maximum Freq (55) is greater than 26.
Power Loss	①	Drive has sensed a power line loss.
Prechrg Actv	①	Drive is in the initial DC bus precharge state.
Sleep Config		Sleep/Wake configuration error. When Sleep-Wake Mode [178] = Direct, possible causes include: - Drive is stopped and Wake Level [180] < Sleep Level [182] - Digital Inx Sel [361 to 366] is not set to one of the following: Stop=CF, Run, Run Forward, or Run Reverse.

Table 12.4 – Alarm Descriptions (Continued)

Alarm	Type	Description
Speed Ref Cflct	②	Speed Ref A Sel (90) or PI Reference Sel (126) is set to Reserved.
Under-Voltage	①	The bus voltage has dropped below a predetermined value.
User Set Conflict	②	Digital Inputs on Dynamic User Sets do not match. Datalinks on Dynamic User Sets do not match.
VHz Neg Slope	②	Custom V/Hz mode has been selected in Torq Perf Mode (53) and the V/Hz slope is negative.
Waking		The wake timer is counting toward a value that will start the drive.

Table 12.5 – Alarm Names Cross-Referenced by Alarm Numbers

No.[1]	Alarm		No.[1]	Alarm
1	Precharge Active		20	Bipolar Conflict
2	UnderVoltage		21	Motor Type Conflict
3	Power Loss		22	NP Hz Conflict
5	Analog In Loss		23	MaxFreq Conflict
6	IntDBRes OvrHeat		24	VHz Neg Slope
8	Drive OL Level 1		25	IR Volts Range
9	Drive OL Level 2		26	FluxAmps Ref Rang
10	Decel Inhibit		27	Speed Ref Cflct
11	Waking		28	Ixo Vlt Rang
17	Dig In ConflictA		29	Sleep Config
18	Dig In ConflictB		30	DigIn Bad Value
19	Dig In ConflictC		32	User Set Conflict

[1] Alarm numbers not listed are reserved for future use.

12.5 About Faults

Faults indicate conditions within the drive that require immediate attention. The drive responds to a fault by initiating a coast-to-stop sequence and turning off output power to the motor.

In addition, some faults are auto-resettable, non-resettable, and/or user-configurable as described in table 12.6.

Table 12.6 – Fault Types

Type	Fault Description	
①	Auto-Reset/Run	If the drive is running when this type of fault occurs, and Auto Rstrt Tries (174) is set to a value greater than 0, a user-configurable timer, Auto Rstrt Delay (175) begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resettable	This type of fault normally requires drive or motor repair. The cause of the fault must be corrected before the fault can be cleared. The fault will be reset on power up after repair.
③	User-Configurable	These faults can be enabled/disabled to either annunciate or ignore a fault condition using Fault Config 1 (238).

The drive indicates faults in the following ways:

- Ready LED on the drive cover (see section 12.3).
- Drive status parameters Drive Status 1 (209) and Drive Status 2 (210).
- Entries in the fault queue (see section 12.5.1).
- Pop-up screen on the LCD OIM. See figure 12.4. The screen displays:
  - Fault number
  - Fault name
  - Time that has elapsed since fault occurred.

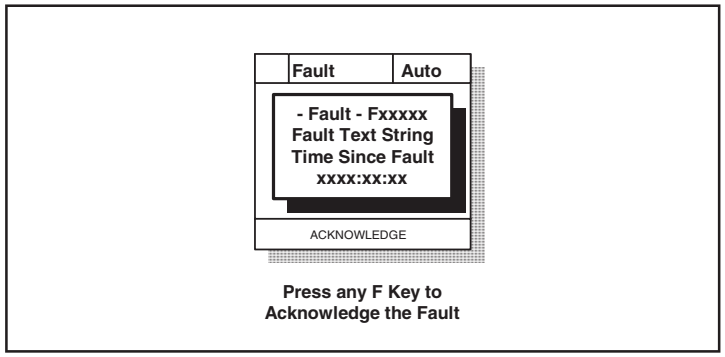


Figure 12.4 – Sample Fault Screen on the LCD OIM

The fault screen is displayed until it is acknowledged by pressing any F-key or cleared in the drive by other means.

12.5.1 About the Fault Queue

The drive automatically retains a history of faults that have occurred in the fault queue. The fault queue is accessed using the OIM or VS Utilities software.

The fault queue holds the eight most recent faults. The last fault to occur is indicated in queue entry #1. As new faults are logged into the queue, existing fault entries are shifted (for example, entry #1 will move to entry #2). Once the queue is full, older faults are discarded from the queue as new faults occur.

All entries in the fault queue are retained if power is lost.

The Time Stamp

For each entry in the fault queue, the system also displays a fault code and time stamp value. The time stamp value is the value of an internal drive-under-power timer at the time of the fault. The value of this timer is copied to PowerUp Marker (242) when the drive powers up. The fault queue time stamp can then be compared to the value in PowerUp Marker to determine when the fault occurred relative to the last drive power up.

The time stamp is cleared when the fault queue is cleared.

Refer to section 12.8.1 for information on accessing the fault queue using the LCD OIM.

12.5.2 Clearing Faults

A fault condition can be cleared by the following:

Step 1. Press ESC/PROG or any F-Key to acknowledge the fault and remove the fault pop-up from the LCD OIM screen.

Step 2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared.

Step 3. After corrective action has been taken, clear the fault using one of the following:

- Setting Fault Clear (240) to Clear Faults (1).
- Press F1 (Cflt) from the fault queue screen.
- Issuing a Stop-Clear Faults command from the control source.

Resetting faults will clear the faulted status indication. If any fault condition still exists, the fault will be latched, and another entry made in the fault queue.

Note that performing a fault reset does not clear the fault queue. Clearing the fault queue is a separate action. See the Fault Clear (240) parameter description.

12.5.3 Fault Descriptions and Corrective Actions

Table 12.7 describes drive faults and corrective actions. It also indicates if the fault is

① Auto-resettable

② Non-resettable

③ User-configurable

Table 12.7 – Fault Descriptions and Corrective Actions

Fault	No.	Type	Description	Action
Analog In Loss	29	① ③	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with Anlg In 1, 2 Loss (324, 327).	1. Check parameters. 2. Check for broken/loose connections at inputs.
Anlg Cal Chksum	108	②	The checksum read from the analog calibration data does not match the checksum calculated.	Replace drive.
Auto Rstrt Tries	33	③	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of Auto Rstrt Tries (174). Enable/disable with Fault Config 1 (238).	Correct the cause of the fault and manually clear.
AutoTune Aborted	80		The autotune procedure was canceled by the user.	Restart procedure.
DB Resistance	69		Resistance of the internal DB resistor is out of range.	Replace resistor.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Decel Inhibit	24	③	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.	1. Verify input voltage is within drive specified limits. 2. Verify system ground impedance follows proper grounding techniques. 3. Disable bus regulation and/or add dynamic brake resistor and/or extend deceleration time. 4. May disable fault at Fault Config 1(238) bit 6 = 0. 5. Verify speed reference signal is stable.
Drive OverLoad	64		Drive rating of 110% for 1 minute or 150% for 3 seconds has been exceeded.	Reduce load or extend Accel Time (140).
Excessive Load	79		Motor did not come up to speed in the allotted time.	1. Uncouple load from motor. 2. Repeat Autotune (61).
FluxAmpsRef Rang	78		The value for flux amps determined by the autotune procedure exceeds the programmed Motor NP FLA (42).	1. Reprogram Motor NP FLA (42) with the correct motor nameplate value. 2. Repeat Autotune (61). 3. Verify Motor NP Power (45) and IR Voltage Drop (62) are set correctly.
Function Loss	2	①	Function loss input is open.	Check remote wiring.
Ground Fault	13	①	A current path to earth ground greater than 25% of drive rating.	Check the motor and external wiring to the drive output terminals for a grounded condition.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Heatsink OvrTemp	8	①	Heatsink temperature exceeds a predefined value of 90°C (195°F).	1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) NEMA Type 1 installations or 50°C (122°F) for Open type installations. 2. Check fan.
HW OverCurrent	12	①	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current. Motor dynamics cannot be accommodated by autotuning. Manual tuning of the current loop required. Consult technical support. Check motor lead wiring.
Incompat MCB-PB	106	②	Drive rating information stored on the power board is incompatible with the Main Control board.	Load compatible version files into drive.
I/O Comm Loss	121	②	Loss of communication to I/O board.	Cycle power.
I/O Board Fail	122		Board failure.	1. Cycle power. 2. If fault repeats, replace I/O board
I/O Mismatch	120		Incorrect I/O board identified.	Restore I/O board to original configuration, or If new configuration is desired, reset fault.
IR Volts Range	77		The drive autotuning default is Calculate and the value calculated for IR Drop Volts is not in the range of acceptable values.	Re-enter motor nameplate data.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Motor Overload	7	① ③	Internal electronic overload trip. Enable/disable with Fault Config 1 (238).	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by Motor NP FLA (42).
OverSpeed Limit	25	①	Functions such as slip compensation or bus regulation have attempted to add an output frequency adjustment greater than that programmed in Overspeed Limit (83).	Remove excessive load or overhauling conditions or increase Overspeed Limit (83).
OverVoltage	5	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
Parameter Chksum	100	②	The checksum read from the board does not match the checksum calculated.	1. Restore defaults. 2. Reload user set if used.
Params Defaulted	48		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
Phase Imbalance	37		Phase current displayed in Imbalance Display (221) > percentage set in Imbalance Limit (49) for time set in Imbalance Time (50).	Clear fault.
Phase U to Grnd	38		A phase-to-ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive.
Phase V to Grnd	39			
Phase W to Grnd	40			

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Phase UV Short	41		Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive.
Phase VW Short	42			
Phase UW Short	43			
Port 1-6 DPI Loss	81-86		DPI port stopped communicating. An attached peripheral with control capabilities via Logic Source Sel (89) (or OIM control) was removed. The fault code indicates the offending port number (81 = port 1, etc.)	1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters, Main Control board or complete drive as required. 2. Check OIM connection.
Port 1-6 Net Loss	71-76		The network card connected to DPI port stopped communicating. The fault code indicates the offending port number (71 = port 1, etc.)	1. Check communication adapter board for proper connection to external network. 2. Check external wiring to adapter on port. 3. Verify external network fault.
Power Loss	3	① ③	DC bus voltage remained below 85% of nominal for longer than Power Loss Time (185). Enable/disable with Fault Config 1 (238).	Monitor the incoming AC line for low voltage or line power interruption.
Power Unit	70		One or more of the output transistors were operating in the active region instead of desaturation. This can be caused by excessive transistor current or insufficient base drive voltage.	1. Check for damaged output transistors. 2. Replace drive.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Pwr Brd Chksum1	104		The checksum read from the EEPROM does not match the checksum calculated from the EEPROM data.	Clear the fault or cycle power to the drive.
Pwr Brd Chksum2	105	②	The checksum read from the board does not match the checksum calculated.	1. Cycle power to the drive. 2. If problem persists, replace drive.
Replaced MCB-PB	107	②	Main Control board was replaced and parameters were not programmed.	1. Restore defaults. 2. Reprogram parameters.
Shear Pin	63	③	Programmed Current Lmt Val (148) has been exceeded. Enabled/disable with Fault Config 1 (238).	Check load requirements and Current Lmt Val (148) setting.
SW OverCurrent	36	①	The drive output current has exceeded the software current.	Check for excess load, improper DC boost setting. DC brake volts set too high.
Trnsistr OvrTemp	9	①	Output transistors have exceeded their maximum operating temperature.	1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for NEMA Type 1 installations or 50°C (122°F) for Open type installations. 2. Check fan.
UnderVoltage	4	① ③	DC bus voltage fell below the minimum value of 160V DC at 200/240V input, 300V DC at 400/480V input or 375V DC at 575V input. Enable/disable with Fault Config 1(233).	Monitor the incoming AC line for low voltage or power interruption.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
UserSet1 Chksum	101	②	The checksum read from the user set does not match the checksum calculated.	Re-save user set.
UserSet2 Chksum	102	②		
UserSet3 Chksum	103	②		

Table 12.8 – Fault Names Cross-Referenced by Fault Number

No.[1]	Fault		No.[1]	Fault		No.[1]	Fault
2	Function Loss		38	Phase U to Grnd		80	AutoTune Aborted
3	Power Loss		39	Phase V to Grnd		81-86	Port 1-6 DPI Loss
4	UnderVoltage		40	Phase W to Grnd		100	Parameter Chksum
5	OverVoltage		41	Phase UV Short		101	UserSet1 Chksum
7	Motor Overload		42	Phase VW Short		102	UserSet2 Chksum
8	Heatsink OvrTemp		43	Phase UW Short		103	UserSet3 Chksum
9	Trnsistr OvrTemp		48	Params Defaulted		104	Pwr Brd Chksum1
12	HW OverCurrent		63	Shear Pin		105	Pwr Brd Chksum2
13	Ground Fault		64	Drive Overload		106	Incompat MCB-PB
24	Decel Inhibit		69	DB Resistance		107	Replaced MCB-PB
25	OverSpeed Limit		70	Power Unit		108	Anlg Cal Chksum
29	Analog In Loss		71-76	Port 1-6 Net Loss		120	I/O Board Mismatch
33	Auto Rstrt Tries		77	IR Volts Range		121	I/O Board Comm Loss
36	SW OverCurrent		78	FluxAmpsRef Rang		122	I/O Board Fail
			79	Excessive Load			

[1] Fault numbers not listed are reserved for future use.

12.6 Common Symptoms and Corrective Actions

Table 12.9 – Drive Does Not Start From Terminal Block Logic

Indication(s)	Cause(s)	Corrective Action
Flashing red Ready LED.	Drive is faulted.	Clear fault: • Press OIM stop key if that OIM is control source. • Cycle power. • Set Fault Clear (240) to 1. • Toggle terminal block stop or terminal block reset digital input if terminal block is the control source.
Incorrect operation from the terminal block.	Incorrect input wiring. • 2-wire control requires Run, Run Forward, or Run Reverse input(s). • 3-wire control requires Start and Stop inputs • Jumper from terminal 7 to 8 is required.	Wire inputs correctly and/or install jumper.
	Incorrect digital input programming. • Mutually exclusive choices have been made. • 2-wire and 3-wire programming may be conflicting. • Exclusive functions (i.e, direction control) may have multiple inputs configured. • Stop if factory default and is not wired or is open. • Start or Run programming may be missing.	Program Digital In”x” Sel (361-366) for correct inputs.
	Logic Source Sel is not set to Terminal Blk.	Set Logic Source Sel to Terminal Blk.

Table 12.9 – Drive Does Not Start From Terminal Block Logic

Indication(s)	Cause(s)	Corrective Action
Flashing yellow Ready LED and DigIn CflctB indication on LCD OIM. Drive Status 2 (210) shows type 2 alarm(s).	Incorrect digital input programming. • Mutually exclusive choices have been made. • 2-wire and 3-wire programming may be conflicting. • Exclusive functions (i.e, direction control) may have multiple inputs configured. • Stop if factory default and is not wired or is open. • Start or Run programming may be missing.	Program Digital In"x" Sel (361-366) to resolve conflicts. Remove multiple selections for the same function. Install stop button to apply a signal at stop terminal.

Table 12.10 – Drive Does Not Start From OIM

Indication	Cause(s)	Corrective Action
None	Drive is programmed for 2-wire control and Logic Source Sel (89) = All Ports. OIM start and network start are disabled for 2-wire control.	If 2-wire control is required, no action is necessary. If 3-wire control is required, program Digital Inx Sel (361-366) for correct inputs.
Flashing or steady red Ready LED.	Active fault.	Reset fault.
Flashing yellow Ready LED.	Enable input is open.	Close terminal block enable input.
	The terminal block stop input is open and control source is set to All Ports.	Close terminal block stop input.
	Start inhibit bits are set.	Check status in Start Inhibits (214).

Table 12.10 – Drive Does Not Start From OIM (Continued)

Indication	Cause(s)	Corrective Action
Drive Status 1 (209) indicates logic control source.	Logic Source Sel (89) is not equal to the desired OIM (Local OIM, DPI Port 2, or DPI Port 3). DPI Port 2 is required for remote OIM.	Verify setting of Logic Source Sel (89). The OIM Control digital input effectively sets the control source to the lowest attached OIM port.

Table 12.11 – Drive Does Not Respond to Changes in Speed Command

Indication	Cause(s)	Corrective Action
LCD OIM Status Line indicates “At Speed” and output is 0 Hz.	No value is coming from the source of the command.	1. If the source is an analog input, check wiring and use a meter to check for presence of signal. 2. Check Commanded Freq (2) for correct source.
None	Incorrect reference source has been programmed.	1. Check Speed Ref Source (213) for the source of the speed reference. 2. Reprogram Speed Ref A Sel (90) for correct source.
None	Incorrect reference source is being selected via remote device or digital inputs.	1. Check Drive Status 1 (209), bits 12 - 15 for unexpected source selections. 2. Check Dig In Status (216) to see if inputs are selecting an alternate source. 3. Reprogram digital inputs to correct Speed Sel x option.
Speed reference from analog input	Improper reference common signal wiring.	1. Verify that common is properly connected to AnlgIn(-) terminal.

Table 12.12 – Motor and/or Drive Will Not Accelerate to Commanded Speed

Indication	Cause(s)	Corrective Action
Acceleration time is excessive.	Incorrect value in Accel Time “x” (140, 141).	Reprogram Accel Time “x” (140, 141).
Drive is forced into current limit, slowing or stopping acceleration.	Excess load or short acceleration time.	Check Drive Status 2 (210), bit 10 to see if the drive is in current limit. Remove excess load or reprogram Accel Time “x” (140, 141).
Speed command source or value is not as expected.	Improper speed command.	Check for the proper speed command using steps 1 through 7 in table 12.11.
Programming is preventing the drive output from exceeding limiting values.	Incorrect programming.	Check Maximum Speed (82) and Maximum Freq (55) to insure that speed is not limited by programming.

Table 12.13 – Motor Operation is Unstable

Indication	Cause(s)	Corrective Action
None	Motor data was incorrectly entered or autotune was not performed.	1. Correctly enter motor nameplate data. 2. Perform static or rotate autotune procedure (61).

Table 12.14 – Stopping the Drive Results in a Decel Inhibit Fault

Indication	Cause(s)	Corrective Action
Decel Inhibit fault screen. LCD status line indicates Faulted.	The bus regulation feature is enabled and is halting deceleration due to excessive bus voltage. Excess bus voltage is normally due to excessive regenerated energy or unstable AC line input voltages. Internal timer has halted drive operation.	1. Reprogram bus regulation (parameters 161 and 162) to eliminate any Adjust Freq selection. 2. Disable bus regulation (parameters 161 and 162) and add a dynamic brake. 3. Correct AC input line instability or add an isolation transformer. 4. Reset drive.

12.7 Replacement Parts

Table 12.15 – OIM Cables

Description	Part Number
LCD OIM Cable for remote use	RECBL-LCD
LCD OIM Extender Cable (0.3 meter)	RECBL-F03
LCD OIM Extender Cable (1 meter)	RECBL-F10
LCD OIM Extender Cable (3 meters)	RECBL-F30
LCD OIM Extender Cable (9 meters)	RECBL-F90

Table 12.16 – Drive Unit

Description	Part Number
Controller Board	313876-K01
24 V I/O Board	6SB-024A
120 V I/O Board	6SB-115B

12.8 Troubleshooting the Drive Using the LCD OIM

The LCD OIM provides immediate visual notification of alarm or fault conditions as well as the following diagnostic information:

- Entries in the fault queue
- Fault parameters
- Drive status parameters
- Selected device version and status information
- OIM version information

12.8.1 Accessing the Fault Queue

As described in section 12.5.1, the drive automatically retains a history of the last eight faults that have occurred in the fault queue.

To access the fault queue, press the F4 key at the process display screen, or see figure 12.5 to access the fault queue from the Main Menu.

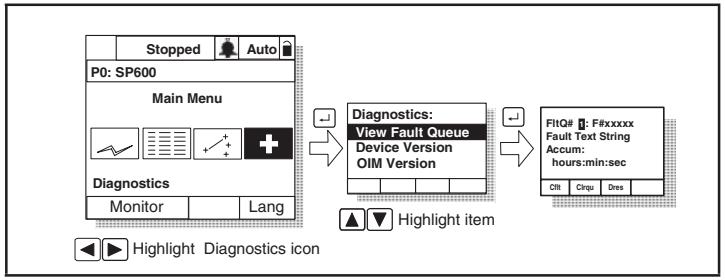


Figure 12.5 – Accessing the Fault Queue

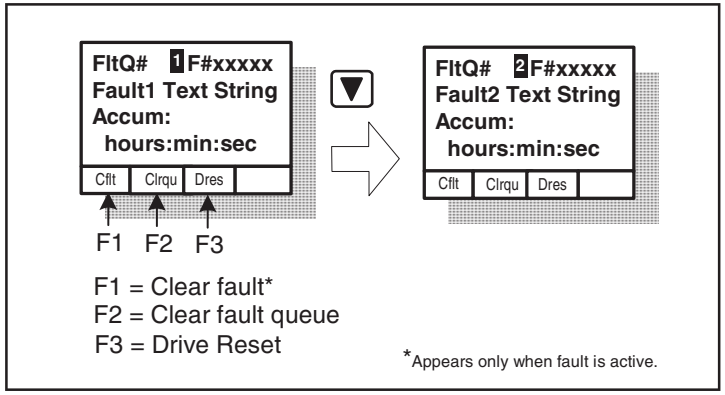


Figure 12.6 – Sample Fault Queue Entry

The drive can be reset (as if the power were cycled) by pressing the F3 (Dres) function key while in the "View Fault Queue" screens. The reset function is active only while the drive is stopped. During a reset, drive communication with peripheral devices will stop until the reset function completes.

ATTENTION: Pressing F3 (Dres) will immediately cause the drive to be reset. This may result in communication errors in other devices attached to the drive which could result in machine damage.

12.8.2 Accessing the Fault Parameters

The LCD OIM provides quick access to the drive's fault parameters by grouping them in the Fault Info submenu. To access these parameters, see figure 12.7.

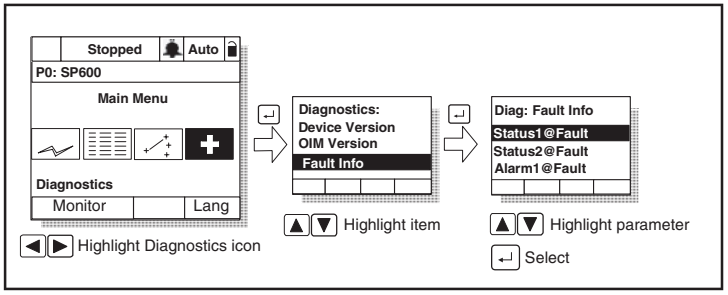


Figure 12.7 – Accessing the Fault Parameters

12.8.3 Accessing the Drive Status Parameters

The LCD OIM provides quick access to the drive status parameters by grouping them in the Status Info submenu. To access these parameters, see figure 12.8.

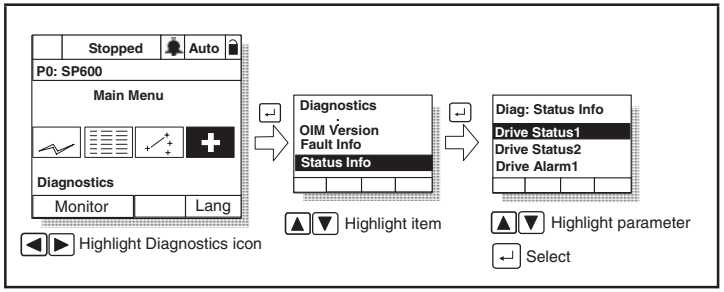


Figure 12.8 – Accessing the Drive Status Parameters

12.8.4 Determining the Product Version

The LCD OIM provides hardware and firmware version information for connected devices, including the OIM, down to the component level.

Device Version

To access the device version information, refer to figures 12.9 and 12.10.

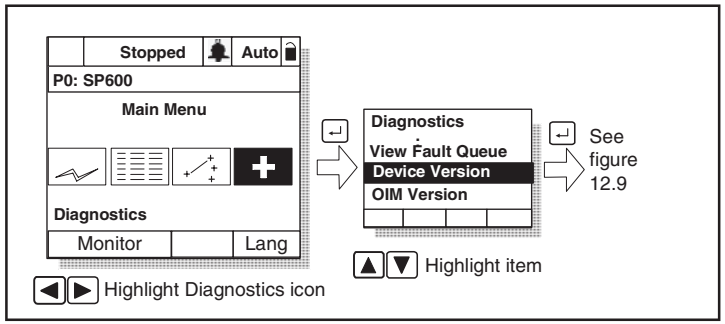


Figure 12.9 – Accessing the Device Version Information

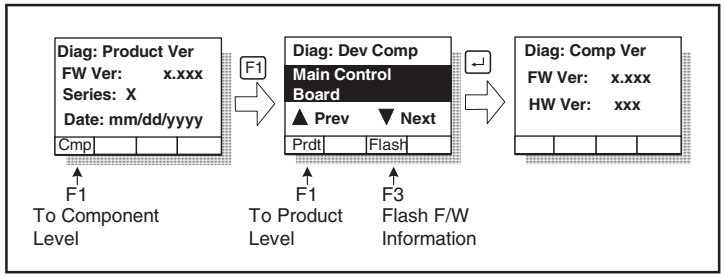


Figure 12.10 – Device Version Screens at Product and Component Levels

OIM Version

The OIM Version selection provides information on the OIM you are using to access this data. See figures 12.11 and 12.12.

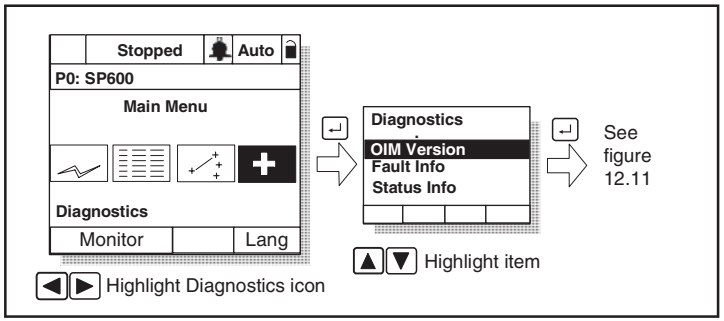


Figure 12.11 – Accessing the OIM Version Information

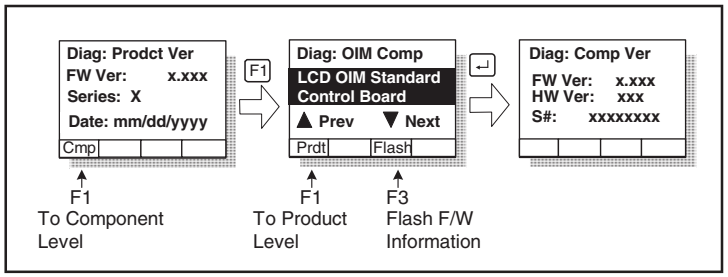


Figure 12.12 – OIM Version Screens at the Product and Component Levels

Device Items

The Device Items selection provides access to a list of diagnostic parameters. These parameters should be adjusted by qualified personnel only. See figure 12.13.

ATTENTION: The parameters in the Device Items menu must be set by a qualified person who understands the significance of setting them accurately. Failure to observe this precaution could result in bodily injury.

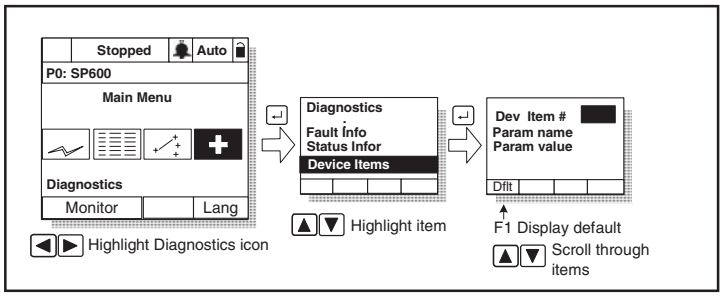


Figure 12.13 – Accessing the Device Item Information

12.8.5 Contacting Tech Support for Assistance

For technical assistance, call 1-864-284-5444. Before calling, please review the troubleshooting section of this manual and check the standard drives website for additional information. When you call this number, you will be asked for the drive model number and this instruction manual number. Also, please have your product version number ready (refer to chapter 12).

APPENDIX A

Technical Specifications

Table A.1 – Drive Monitoring and Limits

AC Input Overvoltage Trip	570 VAC/690 VAC (480 V/575 V Class)
AC Input Undervoltage Trip	280 VAC/345 VAC (480 V/575 V Class)
Bus Overvoltage Trip	810 VDC/1013 VDC (480 V/575 V Class)
Bus Undervoltage Trip	305 VDC/381 VDC (480 V/575 V Class)
Nominal Bus Voltage	648 VDC/810 VDC (480 V/575 V Class)
All Drives	
Heat Sink Thermistor	Monitored by microprocessor overtemp trip
Drive Overcurrent Trip Software Current Limit Hardware Current Limit Instantaneous Current Limit	 20-150% of rated current 200% of rated current (typical) 220-300% of rated current (dependent on drive rating)
Line Transients	up to 6000 volts peak per IEEE C62.41-1991
Control Logic Noise Immunity	Showering arc transients up to 1500V peak
Power Ride-Thru	15 milliseconds at full load
Logic Control Ride-Thru	0.5 seconds minimum, 2 seconds typical
Ground Fault Trip	Phase-to-ground on drive output
Short Circuit Trip	Phase-to-phase on drive output
Intermittent Overload	110% overload capability for up to 1 minute. 150% overload capability for up to 3 seconds.
Current Limit Capability	Proactive Current Limit programmable from 20 to 150% of rated output current. Independently programmable proportional and integral gain.
Electronic Motor Overload Protection	Class 10 protection with speed sensitive response. Investigated by U.L. to comply with N.E.C. Article 430. U.L. File E59272, volume 12.

Table A.2 – Certifications

The drive is designed to meet the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. NEMA 250 - Enclosures for Electrical Equipment IEC 146 - International Electrical Code.	
UL, cUL	UL and cUL Listed to UL508C and CAN/CSA-C2.2 No. 14-M91
CE	Marked for all applicable European Directives EMC Directive (89/336/EEC) Emissions EN 61800-3 Adjustable Speed electrical power drive systems Part 3 Immunity EN 61800-3 Second Environment, Restricted Distribution Low Voltage Directive (73/23/EEC) EN 60204-1 Safety of Machinery – Electrical Equipment of Machines EN 50178 Electronic Equipment for use in Power Installations

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Table A.3 – Environment

Altitude	1000 m (3300 ft) max. without derating
Ambient Operating Temperature without derating:	Ambient Operating Temperature without derating:
NEMA Type 1 / IP20[1] (400V & 480V)	**NEMA Type 1 / IP20[1] (400V & 480V)**
Model Number:	
-027xxxxx	0 to 40°C (32°F to 104°F)
-034xxxxx	0 to 40°C (32°F to 104°F)
-040xxxxx	0 to 40°C (32°F to 104°F)
-052xxxxx	0 to 40°C (32°F to 104°F)
-065xxxxx	0 to 40°C (32°F to 104°F)
-077xxxxx	0 to 40°C (32°F to 104°F)
-096xxxxx	0 to 40°C (32°F to 104°F)
-125xxxxx	0 to 40°C (32°F to 104°F)
-156xxxxx	0 to 40°C (32°F to 104°F)
-180xxxxx	0 to 40°C (32°F to 104°F)
-248xxxxx	0 to 40°C (32°F to 104°F)
NEMA Type Open / IP20[2] (400V & 480V)	**NEMA Type Open / IP20[2] (400V & 480V)**
Model Number:	
-027xxxxx	0 to 50°C (32°F to 122°F)
-034xxxxx	0 to 50°C (32°F to 122°F)
-040xxxxx	0 to 50°C (32°F to 122°F)
-052xxxxx	0 to 50°C (32°F to 122°F)
-065xxxxx	0 to 45°C (32°F to 122°F)
-077xxxxx	0 to 50°C (32°F to 113°F)
-096xxxxx	0 to 50°C (32°F to 122°F)
-125xxxxx	0 to 50°C (32°F to 122°F)
-156xxxxx	0 to 50°C (32°F to 122°F)
-180xxxxx (460V AC Applications)	0 to 50°C (32°F to 122°F)
-180xxxxx (400V AC Applications)	0 to 40°C (32°F to 104°F)
-248xxxxx	0 to 40°C (32°F to 104°F)
NEMA Type Open / IP00[3]	**NEMA Type Open / IP00[3]**
Model Number:	
-065xxxxx (400 VAC applications)	0 to 50°C (32°F to 122°F)

Table A.3 – Environment

Ambient Operating Temperature without derating:	Ambient Operating Temperature without derating:
NEMA Type 1 / IP20[1] (575V)	**NEMA Type 1 / IP20[1] (575V)**
Model Number:	
-022xxxxx	0 to 40°C (32°F to 104°F)
-027xxxxx	0 to 40°C (32°F to 104°F)
-032xxxxx	0 to 40°C (32°F to 104°F)
-041xxxxx	0 to 40°C (32°F to 104°F)
-052xxxxx	0 to 40°C (32°F to 104°F)
-062xxxxx	0 to 40°C (32°F to 104°F)
-077xxxxx	0 to 40°C (32°F to 104°F)
-099xxxxx	0 to 40°C (32°F to 104°F)
-125xxxxx	0 to 40°C (32°F to 104°F)
-144xxxxx	0 to 40°C (32°F to 104°F)
NEMA Type Open / IP20[2] (575V)	**NEMA Type Open / IP20[2] (575V)**
Model Number:	
-022xxxxx	0 to 50°C (32°F to 122°F)
-027xxxxx	0 to 50°C (32°F to 122°F)
-032xxxxx	0 to 50°C (32°F to 122°F)
-041xxxxx	0 to 50°C (32°F to 122°F)
-052xxxxx	0 to 50°C (32°F to 122°F)
-062xxxxx	0 to 50°C (32°F to 113°F)
-077xxxxx	0 to 50°C (32°F to 122°F)
-099xxxxx	0 to 50°C (32°F to 122°F)
-125xxxxx	0 to 50°C (32°F to 122°F)
-144xxxxx	0 to 50°C (32°F to 122°F)
NEMA Type Open / IP00[3]	**NEMA Type Open / IP00[3]**
Model Number:	
-065xxxxx (400 VAC Applications)	0 to 50°C (32°F to 122°F)
Storage Temperature (all const.)	–40 to 70°C (–40 to 158°F)
Atmosphere	**Important:** Drive must not be installed in an area where the ambient temperature contains a volatile or corrosive gas, vapors, or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
Relative Humidity	5 to 95% non-condensing
Shock	15G peak for 11ms duration (±1.0 ms)
Vibration	0.152 mm (0.006 in.) displacement, 1G peak

[1] The drive is shipped as NEMA Type 1 / IP20. No action required to meet the indicated ambient.

[2] To convert the drive to NEMA Type Open / IP20 in order to meet the indicated ambient, remove the adhesive label fixed to the top of the drive enclosure.

[3] To operate the -065xxxx drive on 400 VAC and at the indicated ambient, remove the adhesive label fixed to the top of the drive enclosure and the drive enclosure bottom vent plate.

Important: Removing the adhesive label from the drive changes the enclosure rating from Type 1 Enclosed to Open Type.

Table A.4 – Voltage Ratings

Voltage Tolerance	–10% of minimum, +10% of maximum.
Frequency Tolerance	47-63 Hz
Input Phases	Three-phase input provides full rating for all drives. Single-phase operation provides 50% of rated current.
Displacement Power Factor	Range between 1.0 and 0.95 lagging over entire speed range
Efficiency	97.5% at rated amps, nominal line volts.
Max. Short Circuit Current Rating Using Recommended Fuse or Circuit Breaker Type	Maximum short circuit current rating to match specified fuse/circuit breaker capability.

Table A.5 – Control Specifications

Method	Sine coded PWM with programmable carrier frequency. Ratings apply to all drives . The drive can be supplied as 6-pulse or 12-pulse in a configured package.
Carrier Frequency	2-10 kHz. Drive rating based on 4 kHz. 248 amp drive rating based on 2 kHz.
Output Voltage Range	0 to rated motor voltage
Output Frequency Range	0 to 400 Hz.
Frequency Accuracy Digital Input Analog Input	 Within ±0.01% of set output frequency. Within ±0.4% of maximum output frequency.
Speed Regulation Open Loop with Slip Compensation	±0.5% of base speed across 40:1 speed range

Table A.5 – Control Specifications

Selectable Motor Control	Sensorless Vector with full tuning. Standard V/Hz with full custom capability.
Stop Modes	Multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.
Accel/Decel	Two independently programmable accel and decel times. Each time may be programmed from 0 - 3600 seconds in 0.1 second increments.

Table A.6 – Analog Interface Specifications

Analog Input 1, Differential Voltage Input	
Signal level	-10V to +10V
Differential Input resistance	100kΩ
Isolation	160V
Resolution	11 bits plus sign
Input processing period	5ms
Analog Input 1, Differential Current Input	
Signal level	0(4) to 20mA
Differential Input resistance	124Ω
Resolution	11 bits plus sign
Input processing period	5ms
Analog Input 2, Differential Voltage Input	
Signal level	-10V to +10V
Differential Input resistance	100kΩ
Initial accuracy (@25°C)	160V
Resolution	11 bits plus sign
Input processing period	5ms
Analog Input 2, Differential Current Input	
Signal level	0(4) to 20mA
Differential Input resistance	124Ω
Resolution	11 bits plus sign
Input processing period	5ms

Table A.6 – Analog Interface Specifications

Analog Output	
Voltage	
Analog output voltage range	-10V to +10V or 4 to 20 mA
Loading impedance	2kΩ minimum
Resolution	11 bits plus sign
Output processing period	5ms
Current	
Analog output current range	4 to 20 mA
Maximum Load	400Ω
Resolution	11 bits
Output processing period	5ms
Reference Power Supply	
Output Voltage	±10V
Potentiometer resistance range	2kΩ to 10kΩ (15 mA max. load)

Table A.7 – Logic Interface Specifications

24V Power Supply	
Output Voltage	24V to 28V
Output Current	150mA maximum
Six Digital Inputs	**24V I/O board only**
Input voltage	24V (nominal)
Logic thresholds	logic 0: V_{in} < 3.2V; logic 1: V_{in} > 19.2V
Input resistance	2kΩ
Isolation	±25V
Assertion response (hardware only)	9ms maximum
Negation response (hardware only)	1ms maximum
Two Form C Relay Outputs	
Maximum Contact Voltage	250VAC, 220VDC
Contact rating for resistive load	2 A at 250 VAC / 30 VDC
Contact rating for inductive loads	2 A at 250 VAC / 30 VDC

APPENDIX B

Using the LCD OIM

The LCD Operator Interface Module (OIM) is a keypad/display that enables you to program, monitor, and control the drive.

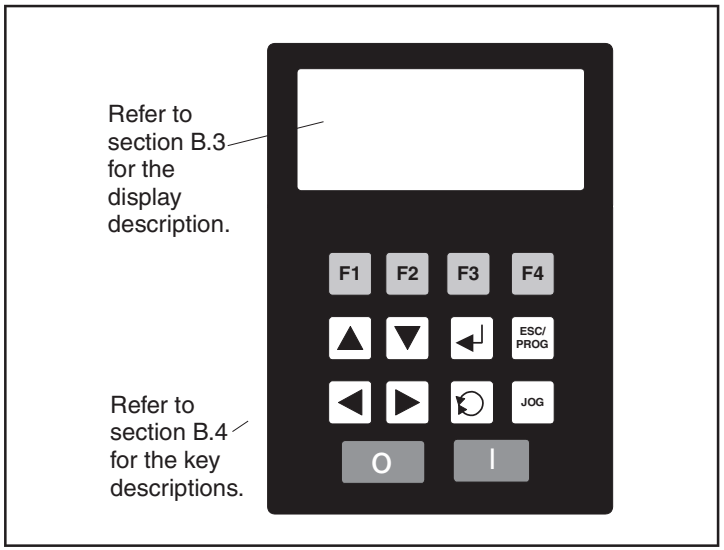


Figure B.1 – SP600 LCD OIM

B.1 Connections

The LCD OIM can be used in the following ways:

Drive mounted - The OIM connects directly to the drive using DPI port 1.

Hand-held - A cable (RECBL-LCD) must be used to convert the OIM for hand-held use. The maximum cable length is 32 feet using extender cables. Connect the cable to either DPI port 2 or 3.

Remote mounted - A NEMA 4 remote mount OIM is available. The maximum cable length is 32 feet using extender cables. Connect the cable to either DPI port 2 or 3.

See figure 2.2 in chapter 2 for the connection points on the drive.

B.2 Installing and Removing the Local LCD OIM

To **install** the local LCD OIM, slide the OIM into the slot on the front of the drive until it clicks into place.

To **remove** the local LCD OIM, press the tab at the top of the drive to release the OIM while pushing the OIM from the bottom to slide it out of the drive.

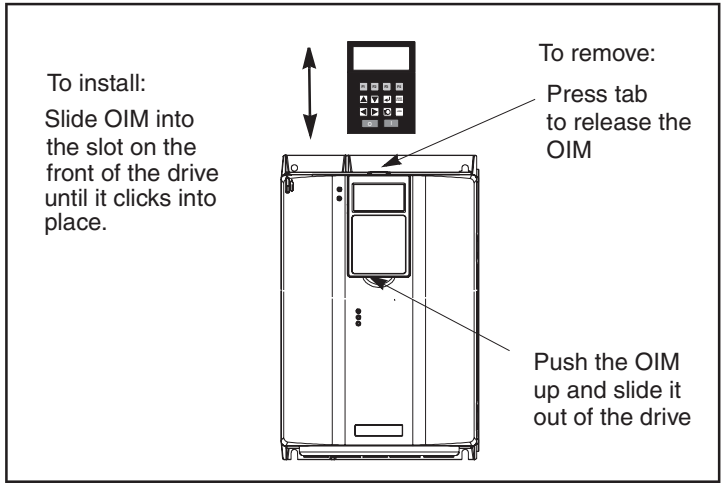


Figure B.2 – Installing and Removing the Local LCD OIM

B.2.1 Removing the Local LCD OIM While the Drive is Powered

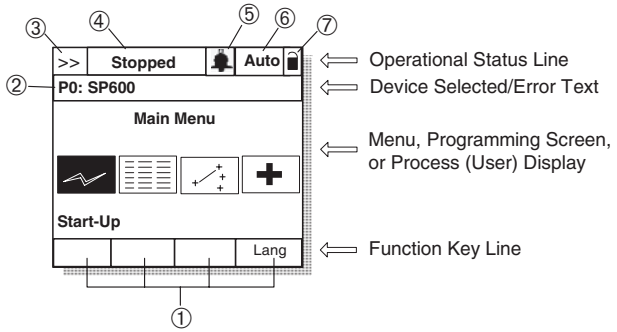
If the local LCD OIM is the selected control source, removing the OIM while the drive is powered will cause a drive fault.

If the local LCD OIM is not the selected control source, but is the reference source, removing the OIM while the drive is powered will result in a zero reference value. When the OIM is replaced, the drive will ramp to the reference level supplied by the OIM.

ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

If the local LCD OIM is not the selected control source or reference source, removing the OIM while the drive is powered will have no effect on drive operation.

B.3 Display Description



①	Function Key (F1, F2, F3, F4) definitions
②	Port/peripheral identification. Identifies port or peripheral on DPI about which the OIM is displaying information. See section B.6.
③	Direction indicator. Indicates actual motor direction.

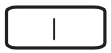
Command Direction	Actual Direction	Indicator
Fwd	Fwd	>>
Rev	Fwd	>> (flashing)
Fwd	Rev	<< (flashing)
Rev	Rev	<<

④	Operating status (for example, Running, Stopped, etc.)
⑤	Alarm annunciation. = Alarm has occurred.
⑥	OIM Auto/Manual mode status. (Not valid for Terminal Strip Mode.)
⑦	Write-protect password status: (unlocked) = password disabled; (locked) = password enabled. See section 10.4

Figure B.3 – The Display (Main Menu Shown)

B.3.1 Key Descriptions

Table B.1 – Key Functions

Key	Function
	Scroll through options or user function keys, move cursor to the left.
	Scroll through options or user functions keys, move cursor to the right.
	Scroll through options, increase a value, or toggle a bit. Increase speed when display is in monitor mode.
	Scroll through options, decrease a value, or toggle a bit. Decrease speed when display is in monitor mode.
	Exit a menu, cancel a change to a parameter, or toggle between program and process (user) display screens.
	Enter a menu, select an option, or save changes to parameter value
	Change motor direction if the OIM is the control source.
	Jog the drive if the OIM is the control source.
	Stop the drive. Clear a fault if the OIM is the control source.
	Start the drive if the OIM is the control source.
	F1 though F4: Predefined or user-configured functions. The definition of each key is shown directly above the key on the display. See item ① in figure B.3.

B.4 LCD OIM Menu Structure

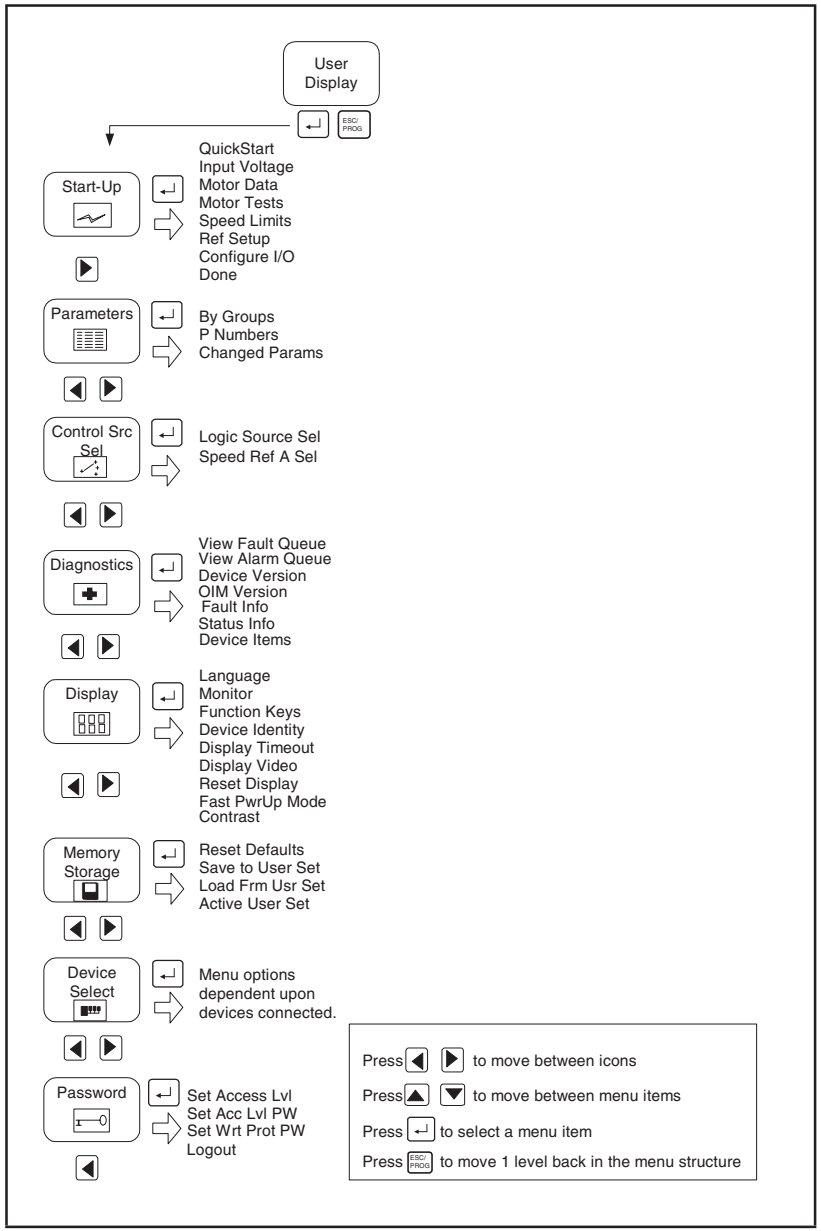


Figure B.4 – LCD OIM Menu Structure

B.5 Powering Up and Adjusting the LCD OIM

The first time the LCD OIM is powered up, you will be prompted to select a language for the display text. If the Start-Up routine has not been completed, the Start-Up menu is displayed immediately following the language selection screen.

On subsequent power ups, if both of these requirements have been met, the Main Menu is displayed after the initialization screen.

B.5.1 Selecting the Fast Power Up Feature

The fast power up feature bypasses the initialization screen at power up, and the Main Menu is displayed immediately. To select this feature, select Fast PwrUp Mode from the Display menu.

B.5.2 Adjusting the Screen Contrast

To adjust the screen contrast, select Contrast from the Display menu.

B.5.3 Resetting the Display

To return all the options for the display to factory-default values, select Reset Display from the Display menu.

B.6 Selecting a Device in the System

The LCD OIM can access and display data from any active drive or peripheral device on the network. The drive (port 0) is the default device selected.

To select a device, select the Device Select icon from the Main Menu. The options listed depend on what is connected to the network.

The name and DPI port number of the device being accessed is shown on the OIM's display (see figure B.3).

B.7 Using the LCD OIM to Program the Drive

The LCD OIM enables you to view and adjust parameters in the drive or in peripheral devices connected to the drive. The parameters available for viewing or adjustment depend on the device selected. See section B.6 for information about selecting a device.

The method of viewing and adjusting parameters is the same regardless of the device selected.

B.7.1 Viewing and Adjusting Parameters

Refer to chapter 10 for information on how to access the parameters in the drive.

Each parameter screen contains the following information:

- Parameter number
- Parameter name
- Current parameter value and units
- Parameter range
- **F1 key defined as a toggle to enable you to view the parameter's current value and the factory-default value**

See figure B.5 and table B.2 for instructions on how to adjust the parameter values.

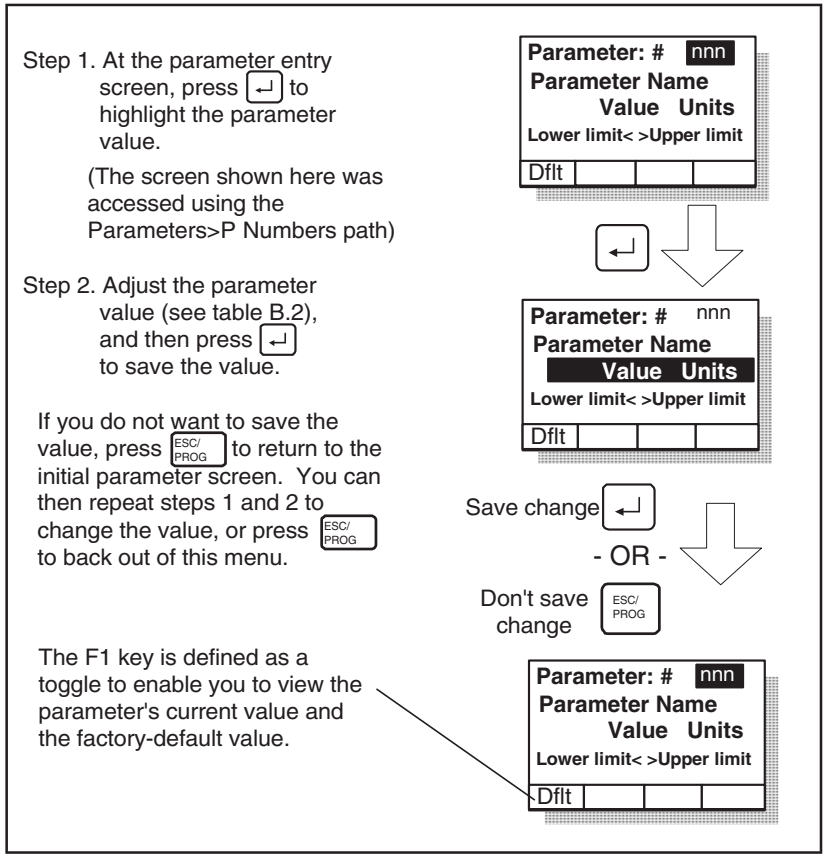


Figure B.5 – Adjusting Parameters

Table B.2 – How to Adjust Each Parameter Type

Parameter Type	How to Adjust
Numbered List	Use up/down arrow keys to advance through the list of options.
Bit	Use ◀ ▶ to move the cursor to the bit location you want to change. Use ▲ ▼ to change the value of the bit.
Numeric	Use ▲ ▼ to increase or decrease the value. - Or - Use ◀ ▶ to move the cursor from digit to digit, and use ▲ ▼ to increase or decrease the value of the digit.

To restore all parameters to their factory-default values, select Reset Defaults from the Memory Storage menu.

Note that the parameter values are retained through a line dip or power shutdown.

B.7.2 Loading and Saving User Sets

Drive configurations, called user sets, can be saved and recalled for use at any time. Up to three user sets can be saved in the SP600 drive.

To **save** the current drive configuration, select Save to User Set from the Memory Storage menu. User Sets can not be saved if Dynamic User Sets are enabled.

To recall, or **load**, a user set, select Load Frm Usr Set from the Memory Storage menu. User Sets can not be restored if Dynamic User Sets are enabled.

To **identify** which user set is active, select Active User Set from the Memory Storage menu. The name of the last user set to be loaded into the drive will be displayed. “Active Set” means factory defaults have been restored.

B.8 Monitoring the Drive Using the Process Display Screen on the LCD OIM

The process display screen enables you to monitor up to three process variables (six on frames 2 and 3. Use a function key programmed as Next to toggle between the process display variables). You can select the display, parameter, scale, and text for each process variable being displayed.

The ESC/PROG key toggles between the programming screen and the process display screen. From the Main Menu screen, press F1 or F2 to select the process display screen. In addition, the process display screen becomes active if no keys have been pressed before the display timeout period expires. See section B.8.4 for information about setting the display timeout period.

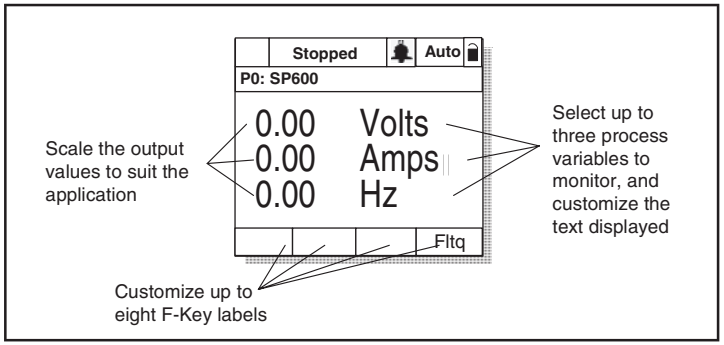


Figure B.6 – Process (User) Display Screen

B.8.1 Displaying and Changing the OIM Reference

You can display the reference value that the OIM is sending to the drive by pressing the up or down arrow key once when the process display screen is active. See figure B.7. The OIM reference can be used for the speed reference, PI reference, or trim reference.

While the display is in the Monitor Mode, the speed reference can by changed by pressing and holding down either the up or down arrow key until the desired value is displayed. Release the key to return to the process display screen.

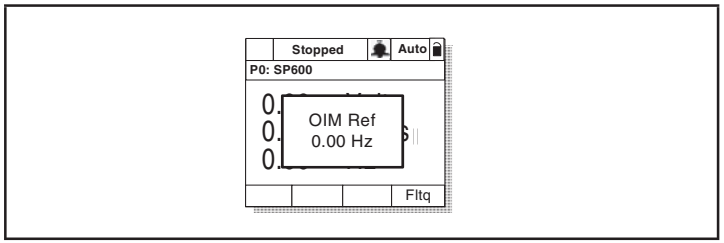


Figure B.7 – OIM Reference Displayed

Note that changing the value of the OIM reference does not affect the value of any other port reference.

The value of the OIM reference is saved through a power cycle if parameter 192 (Save OIM Ref) is set to save at power down.

B.8.2 Customizing the Process Display Screen

To customize the process display screen, select Monitor from the Display menu. See figure B.8.

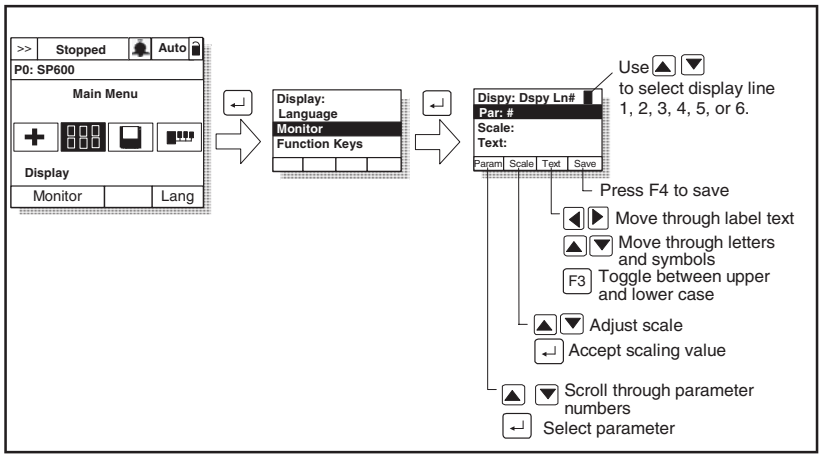


Figure B.8 – Customizing the Process Display Screen

B.8.3 Customizing the Function Keys

The function keys (F1, F2, F3, and F4, also called F-Keys) on the OIM can be customized to perform several pre-configured functions when the process display screen is active.

Up to eight function keys can be configured. Pressing ◀ ▶ while the display screen is active toggles between each set of four functions.

As shipped from the factory, the F1 key is configured for the Auto/Manual selection function and the F4 key is configured for the Clear Fault Queue function.

To assign a function to an F-Key, select the Display icon from the Main Menu as shown in figures B.9 and B.10.

The F-Key definitions are the same for all OIMs connected to the drive, regardless of the port used.

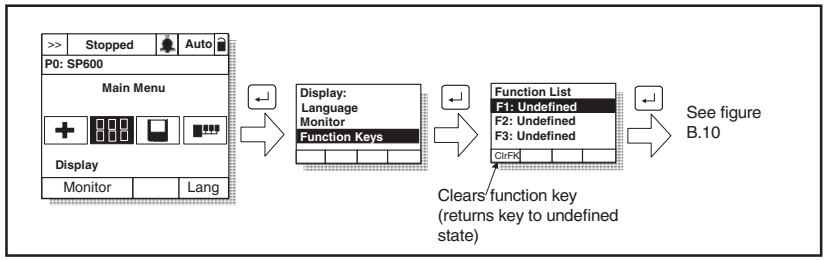


Figure B.9 – Accessing the Function Key Configuration Screens

Select from the list of preconfigured functions:

Undefined (default)

Load User Set 1-3: Loads the specified user set into active drive memory. The drive responds as if a value had been entered in Load Frm User Set (198), or Load Frm Usr Set was selected from the OIM's Memory Storage menu.

ATTENTION: Loading a user set with LevelSense Start (168) set to Enable can result in the drive starting immediately when all start conditions are met.

When this function is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Save User Set 1-3: Saves the active configuration to drive memory. The drive responds as if a value had been entered in Save to User Set (199) or Save to User Set was selected from the OIM's Memory Storage menu.

Acc/Dec Change: Toggles between the display of Acc/Dec rate 1 and Acc/Dec rate 2 (The value the drive is configured to go to, not the current value being used by the drive). This selection is based on the active value of the rate parameters (140-143). Therefore, when any of these parameters change, the actual acc/dec rates will dynamically change.

Preset Speed 1-6: Toggles the selected preset speed on and off and grants Manual reference control. Returns to Auto reference when the function is toggled.

Auto/Manual: Toggles between Auto and Manual reference control. The text above the function key will change to indicate the command that will be issued when the key is pressed.

> **ATTENTION:** When switching from Auto to Manual or Manual to Auto, the drive will ramp to the reference level provided by the new source at the rate specified in Accel Time 1 (140), Decel Time 1 (142), Accel Time 2 (141), or Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

View Fault Queue: Displays the Fault Queue screen (see chapter 12). Press ESC/PROG to return to the process display screen.

Next: Toggles to next set of three process display variables.

B.8.3.1 Customizing the Function Key Label Text

You can customize the text for each function key label (up to five characters). See figure B.10.

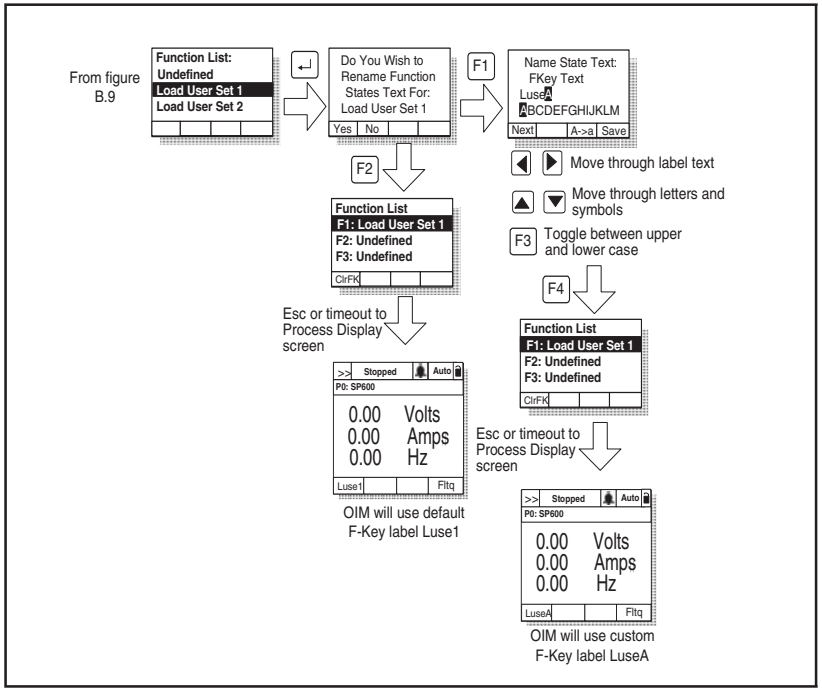


Figure B.10 – Customizing the Function Key Label Text

B.8.4 Setting the Display Timeout Period

When the OIM is inactive (that is, no keys have been pressed) for a user-specified period of time, the process display screen becomes active. To return to the previously active screen, press any key. To return to the Main Menu, press ESC/PROG.

To set the display timeout period, select Display Timeout from the Display menu. The timeout period can range from 10 to 1200 seconds (20 minutes).

This feature can also be disabled by pressing the F1 key while in the display time screen.

Note that each OIM connected to the drive can have a different timeout period.

B.8.5 Using Reverse Video for the Process Display Screen

To select normal or reverse video for the process display screen, select Display Video from the Display menu. See figure B.11 for sample screens.

Note that each OIM connected to the drive can have a different display mode.

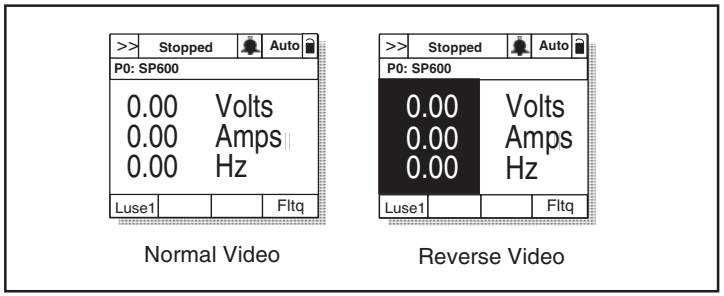


Figure B.11 – Selecting Reverse Video for the Process Display Screen

B.9 Controlling the Drive From the LCD OIM

When the OIM is the selected control source, it can be used to control the drive:

- Start (Run)
- Stop
- Clear Faults
- Jog
- Select direction

Note that pressing two OIM keys at the same time will cause no command to be sent to the drive. For example, attempting to

change direction while jogging from the same OIM will cause the drive to stop.

B.9.1 Selecting the Logic and Reference Source

Parameters 89 (Logic Source Sel) and 90 (Ref Source Sel) are used to select the drive control and speed reference sources. These parameters are grouped in the Control Src Select menu. See figure B.12.

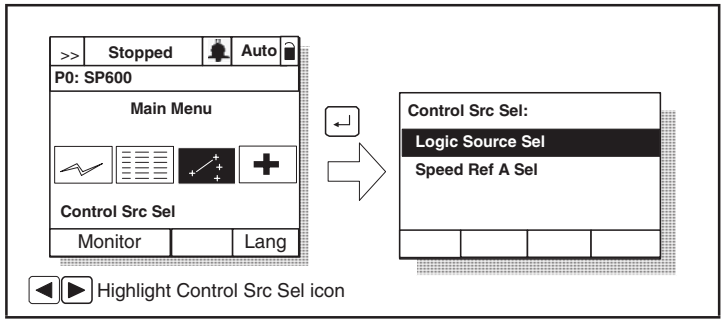


Figure B.12 – Selecting the Control and Reference Source

ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Both of these parameters can also be accessed individually through the Parameters menu.

Refer to chapter 12 for a description of the parameters.

B.9.2 Starting the Drive

When the OIM is the selected control source, pressing [I] issues a start command to the drive.

B.9.3 Stopping the Drive

Pressing [O] will issue a stop command to the drive.

Important: Stop commands from any attached OIM will always be enabled.

B.9.4 Changing Motor Direction

When the OIM is the selected control source, pressing  toggles motor direction.

When  is pressed, the motor ramps down to 0 Hz and then ramps up to the set speed in the opposite direction.

If the drive is running when the direction is changed, the reference to the motor changes based on Accel/Decel time.

B.9.5 Jogging the Drive

When the OIM is the selected control source, pressing 

sends a jog command to the motor as long as the key is pressed.

APPENDIX C

Parameters Cross-Referenced by Name

The following table lists the complete set of SP600 parameters in alphabetical order.

Parameter Name	No.	Path (File>Group)	Page No.
Accel Time 1	140	Dynamic Control>Ramp Rates	11-36
Accel Time 2	141	Dynamic Control>Ramp Rates	11-36
Alarm 1 @ Fault	229	Utility>Diagnostics	11-66
Alarm 2 @ Fault	230	Utility>Diagnostics	11-66
Alarm Config 1	259	Utility>Alarms	11-69
Analog In 1 Hi	322	Inputs & Outputs>Analog Inputs	11-77
Analog In 1 Lo	323	Inputs & Outputs>Analog Inputs	11-77
Analog In 1 Loss	324	Inputs & Outputs>Analog Inputs	11-78
Analog In 2 Hi	325	Inputs & Outputs>Analog Inputs	11-78
Analog In 2 Lo	326	Inputs & Outputs>Analog Inputs	11-79
Analog In 2 Loss	327	Inputs & Outputs>Analog Inputs	11-79
Analog In1 Value	16	Monitor>Metering	11-8
Analog In2 Value	17	Monitor>Metering	11-8
Analog Out1 Hi	343	Inputs & Outputs>Analog Outputs	11-81
Analog Out1 Lo	344	Inputs & Outputs>Analog Outputs	11-82
Analog Out1 Sel	342	Inputs & Outputs>Analog Outputs	11-81
Anlg In Config	320	Inputs & Outputs>Analog Inputs	11-76
Anlg In Sqr Root	321	Inputs & Outputs>Analog Inputs	11-76
Anlg Out Absolut	341	Inputs & Outputs>Analog Outputs	11-80
Anlg Out Config	340	Inputs & Outputs>Analog Outputs	11-80
Auto Rstrt Delay	175	Dynamic Control>Stop/Restart Modes	11-46
Auto Rstrt Tries	174	Dynamic Control>Stop/Restart Modes	11-44

Parameter Name	No.	Path (File>Group)	Page No.
Autotune	61	Motor Control>Torq Attributes	11-16
Break Frequency	72	Motor Control>Volts per Hertz	11-18
Break Voltage	71	Motor Control>Volts per Hertz	11-18
Bus Reg Kd	165	Dynamic Control>Stop/Brake Modes	11-43
Bus Reg Ki	160	Dynamic Control>Stop/Brake Modes	11-40
Bus Reg Kp	164	Dynamic Control>Stop/Brake Modes	11-42
Bus Reg Mode A	161	Dynamic Control>Stop/Brake Modes	11-41
Bus Reg Mode B	162	Dynamic Control>Stop/Brake Modes	11-41
CarrierFrequency	151	Dynamic Control>Load Limits	11-38
Commanded Freq	2	Monitor>Metering	11-5
Compensation	56	Motor Control>Torq Attributes	11-14
Control SW Ver	29	Monitor>Drive Data	11-9
Current Lmt Gain	149	Dynamic Control>Load Limits	11-38
Current Lmt Sel	147	Dynamic Control>Ramp Rates	11-37
Current Lmt Val	148	Dynamic Control>Load Limits	11-38
Data In A1 - Link A Word 1	300	Communication>Datalinks	11-73
Data In A2 - Link A Word 2	301	Communication>Datalinks	11-73
Data In B1 - Link B Word 1	302	Communication>Datalinks	11-73
Data In B2 - Link B Word 2	303	Communication>Datalinks	11-73
Data In C1 - Link C Word 1	304	Communication>Datalinks	11-74
Data In C2 - Link C Word 2	305	Communication>Datalinks	11-74
Data In D1 - Link D Word 1	306	Communication>Datalinks	11-74
Data In D2 - Link D Word 2	307	Communication>Datalinks	11-74
Data Out A1 - Link A Word 1	310	Communication>Datalinks	11-74
Data Out A2 - Link A Word 2	311	Communication>Datalinks	11-74
Data Out B1 - Link B Word 1	312	Communication>Datalinks	11-75
Data Out B2 - Link B Word 2	313	Communication>Datalinks	11-75
Data Out C1 - Link C Word 1	314	Communication>Datalinks	11-75
Data Out C2 - Link C Word 2	315	Communication>Datalinks	11-75
Data Out D1 - Link D Word 1	316	Communication>Datalinks	11-75
Data Out D2 - Link D Word 2	317	Communication>Datalinks	11-75
DB Resistor Type	163	Dynamic Control>Stop/Brake Modes	11-42
DC Brake Level	158	Dynamic Control>Stop/Brake Modes	11-39
DC Brake Lvl Sel	157	Dynamic Control>Stop/Brake Modes	11-39
DC Brake Time	159	Dynamic Control>Stop/Brake Modes	11-40
DC Bus Memory	13	Monitor>Metering	11-7

Parameter Name	No.	Path (File>Group)	Page No.
DC Bus Voltage	12	Monitor>Metering	11-7
Decel Time 1	142	Dynamic Control>Ramp Rates	11-37
Decel Time 2	143	Dynamic Control>Ramp Rates	11-37
Dig In Status	216	Utility>Diagnostics Inputs & Outputs>Digital Inputs	11-62
Dig Out Status	217	Utility>Diagnostics Inputs & Outputs>Digital Outputs	11-63
Dig Out1 Level	381	Inputs & Outputs>Digital Outputs	11-90
Dig Out1 OffTime	383	Inputs & Outputs>Digital Outputs	11-91
Dig Out1 OnTime	382	Inputs & Outputs>Digital Outputs	11-91
Dig Out2 Level	385	Inputs & Outputs>Digital Outputs	11-93
Dig Out2 OffTime	387	Inputs & Outputs>Digital Outputs	11-93
Dig Out2 OnTime	386	Inputs & Outputs>Digital Outputs	11-93
Digital In1 Sel	361	Inputs & Outputs>Digital Inputs	11-83
Digital In2 Sel	362	Inputs & Outputs>Digital Inputs	11-83
Digital In3 Sel	363	Inputs & Outputs>Digital Inputs	11-83
Digital In4 Sel	364	Inputs & Outputs>Digital Inputs	11-83
Digital In5 Sel	365	Inputs & Outputs>Digital Inputs	11-83
Digital In6 Sel	366	Inputs & Outputs>Digital Inputs	11-83
Digital Out1 Sel	380	Inputs & Outputs>Digital Outputs	11-89
Digital Out2 Sel	384	Inputs & Outputs>Digital Outputs	11-92
Direction Mode	190	Utility>Direction Config	11-51
Drive Alarm 1	211	Utility>Diagnostics Utility>Alarms	11-60
Drive Alarm 2	212	Utility>Diagnostics Utility>Alarms	11-60
Drive Checksum	203	Utility>Drive Memory	11-55
Drive Logic Rslt	271	Communication>Comm Control	11-70
Drive OL Count	219	Utility>Diagnostics	11-63
Drive OL Mode	150	Dynamic Control>Load Limits	11-38
Drive Ramp Rslt	273	Communication>Comm Control	11-71
Drive Ref Rslt	272	Communication>Comm Control	11-70
Drive Status 1	209	Utility>Diagnostics	11-57
Drive Status 2	210	Utility>Diagnostics	11-58
Drive Temp	218	Utility>Diagnostics	11-63
Dyn UserSet Cnfg	204	Utility>Drive Memory	11-55
Dyn UserSet Sel	205	Utility>Drive Memory	11-56

Parameter Name	No.	Path (File>Group)	Page No.
Dyn UserSet Actv	206	Utility>Drive Memory	11-57
Elapsed MWh	9	Monitor>Metering	11-6
Elapsed Run Time	10	Monitor>Metering	11-7
Fault Amps	225	Utility>Diagnostics	11-64
Fault Bus Volts	226	Utility>Diagnostics	11-64
Fault Clear	240	Utility>Faults	11-68
Fault Clear Mode	241	Utility>Faults	11-68
Fault Config 1	238	Utility>Faults	11-68
Fault Frequency	224	Utility>Diagnostics	11-64
Flux Current	5	Monitor>Metering	11-6
Flux Current Ref	63	Motor Control>Torq Attributes	11-17
Flux Up Mode	57	Motor Control>Torq Attributes	11-15
Flux Up Time	58	Motor Control>Torq Attributes	11-15
Flying Start En	169	Dynamic Control>Stop/Restart Modes	11-44
Flying StartGain	170	Dynamic Control>Stop/Restart Modes	11-44
IR Voltage Drop	62	Motor Control>Torq Attributes	11-17
Ixo Voltage Drop	64	Motor Control>Torq Attributes	11-17
Jog Speed	100	Speed Command>Discrete Speeds	11-25
Language	201	Utility>Drive Memory	11-54
Last Stop Source	215	Utility>Diagnostics	11-62
LevelSense Start	168	Dynamic Control>Stop/Restart Modes	11-43
Load Frm Usr Set	198	Utility>Drive Memory	11-53
Logic Source Sel	89	Speed Command>Control Src Select	11-21
Man Ref Preload	193	Utility>OIM Ref Config	11-52
Manual Mask	286	Communication>Masks & Owners	11-71
Manual Owner	298	Communication>Masks & Owners	11-72
Maximum Freq	55	Motor Control>Torq Attributes	11-13
Maximum Speed	82	Speed Command>Spd Mode & Limits	11-20
Maximum Voltage	54	Motor Control>Torq Attributes	11-13
Minimum Speed	81	Speed Command>Spd Mode & Limits	11-19
MOP Frequency	11	Monitor>Metering	11-7
MOP Rate	195	Utility>MOP Config	11-52
Motor NP FLA	42	Motor Control>Motor Data	11-9
Motor NP Hertz	43	Motor Control>Motor Data	11-10
Motor NP Power	45	Motor Control>Motor Data	11-10
Motor NP RPM	44	Motor Control>Motor Data	11-10

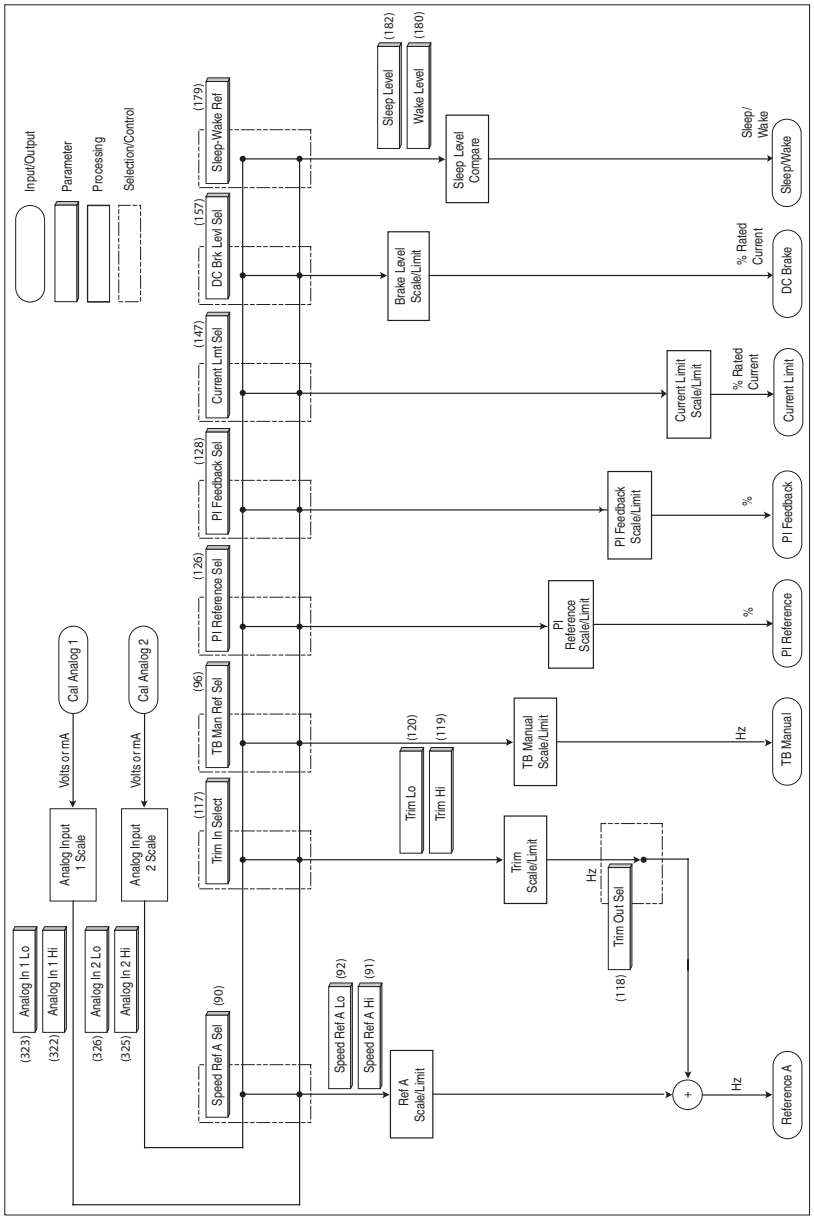
Parameter Name	No.	Path (File>Group)	Page No.
Motor NP Volts	41	Motor Control>Motor Data	11-9
Motor OL Count	220	Utility>Diagnostics	11-64
Motor OL Factor	48	Motor Control>Motor Data	11-12
Motor OL Hertz	47	Motor Control>Motor Data	11-11
Motor Type	40	Motor Control>Motor Data	11-9
Mtr NP Pwr Units	46	Motor Control>Motor Data	11-11
Output Current	3	Monitor>Metering	11-5
Output Freq	1	Monitor>Metering	11-5
Output Power	7	Monitor>Metering	11-6
Output Powr Fctr	8	Monitor>Metering	11-6
Output Voltage	6	Monitor>Metering	11-6
Overspeed Limit	83	Speed Command>Spd Mode & Limits	11-20
Param Access Lvl	196	Utility>Drive Memory	11-53
PI Configuration	124	Speed Command>Process PI	11-29
PI Control	125	Speed Command>Process PI	11-30
PI Error Meter	137	Speed Command>Process PI	11-36
PI Fdback Meter	136	Speed Command>Process PI	11-36
PI Feedback Sel	128	Speed Command>Process PI	11-33
PI Integral Time	129	Speed Command>Process PI	11-33
PI Lower Limit	131	Speed Command>Process PI	11-34
PI Output Meter	138	Speed Command>Process PI	11-36
PI Preload	133	Speed Command>Process PI	11-34
PI Prop Gain	130	Speed Command>Process PI	11-33
PI Ref Meter	135	Speed Command>Process PI	11-35
PI Reference Sel	126	Speed Command>Process PI	11-32
PI Setpoint	127	Speed Command>Process PI	11-32
PI Status	134	Speed Command>Process PI	11-35
PI Upper Limit	132	Speed Command>Process PI	11-34
Power Loss Level	186	Dynamic Control>Power Loss	11-50
Power Loss Mode	184	Dynamic Control>Stop/Power Loss	11-50
Power Loss Time	185	Dynamic Control>Stop/Power Loss	11-50
Power Up Marker	242	Utility>Faults	11-69
Preset Speed 1	101	Speed Command>Discrete Speeds	11-25
Preset Speed 2	102	Speed Command>Discrete Speeds	11-25
Preset Speed 3	103	Speed Command>Discrete Speeds	11-25
Preset Speed 4	104	Speed Command>Discrete Speeds	11-25

Parameter Name	No.	Path (File>Group)	Page No.
Preset Speed 5	105	Speed Command>Discrete Speeds	11-25
Preset Speed 6	106	Speed Command>Discrete Speeds	11-25
Preset Speed 7	107	Speed Command>Discrete Speeds	11-25
Rated Amps	28	Monitor>Drive Data	11-8
Rated kW	26	Monitor>Drive Data	11-8
Rated Volts	27	Monitor>Drive Data	11-8
Reset Meters	200	Utility>Drive Memory	11-54
Reset To Defalts	197	Utility>Drive Memory	11-53
Run Boost	70	Motor Control>Volts per Hertz	11-18
S Curve %	146	Dynamic Control>Ramp Rates	11-37
Save MOP Ref	194	Utility>MOP Config	11-52
Save OIM Ref	192	Utility>OIM Ref Config	11-51
Save To User Set	199	Utility>Drive Memory	11-54
Skip Freq Band	87	Speed Command>Spd Mode & Limits	11-21
Skip Frequency 1	84	Speed Command>Spd Mode & Limits	11-21
Skip Frequency 2	85	Speed Command>Spd Mode & Limits	11-21
Skip Frequency 3	86	Speed Command>Spd Mode & Limits	11-21
Sleep Level	182	Dynamic Control>Restart Modes	11-49
Sleep Time	183	Dynamic Control>Restart Modes	11-49
Sleep-Wake Mode	178	Dynamic Control>Stop/Restart Modes	11-46
Sleep-Wake Ref	179	Dynamic Control>Restart Modes	11-48
Slip Comp Gain	122	Speed Command>Slip Comp	11-28
Slip RPM @ FLA	121	Speed Command>Slip Comp	11-28
Slip RPM Meter	123	Speed Command>Slip Comp	11-28
Speed Mode	80	Speed Command>Spd Mode & Limits	11-18
Speed Ref A Hi	91	Speed Command>Speed References	11-24
Speed Ref A Lo	92	Speed Command>Speed References	11-24
Speed Ref A Sel	90	Speed Command>Control Src Select Speed Command>Speed References	11-23
Speed Ref Source	213	Utility>Diagnostics	11-61
Start Inhibits	214	Utility>Diagnostics	11-61
Start/Acc Boost	69	Motor Control>Volts per Hertz	11-17
Status 1 @ Fault	227	Utility>Diagnostics	11-65
Status 2 @ Fault	228	Utility>Diagnostics	11-65
Stop Mode A	155	Dynamic Control>Stop/Brake Modes	11-39
Stop Mode B	156	Dynamic Control>Stop/Brake Modes	11-39

Parameter Name	No.	Path (File>Group)	Page No.
Stop Owner	288	Communication>Masks & Owners	11-72
SV Boost Filter	59	Motor Control>Torq Attributes	11-15
TB Man Ref Hi	97	Speed Command>Speed References	11-24
TB Man Ref Lo	98	Speed Command>Speed References	11-25
TB Man Ref Sel	96	Speed Command>Speed References	11-24
Testpoint 1 Data	235	Utility>Diagnostics	11-67
Testpoint 1 Sel	234	Utility>Diagnostics	11-67
Testpoint 2 Data	237	Utility>Diagnostics	11-67
Testpoint 2 Sel	236	Utility>Diagnostics	11-67
Torque Current	4	Monitor>Metering	11-5
Torque Perf Mode	53	Motor Control>Torq Attributes	11-12
Trim Hi	119	Speed Command>Speed Trim	11-27
Trim In Select	117	Speed Commands>Speed Trim	11-26
Trim Lo	120	Speed Command>Speed Trim	11-27
Trim Out Select	118	Speed Command>Speed Trim	11-27
Wake Level	180	Dynamic Control>Restart Modes	11-48
Wake Time	181	Dynamic Control>Restart Modes	11-59
Voltage Class	202	Utility>Drive Memory	11-55

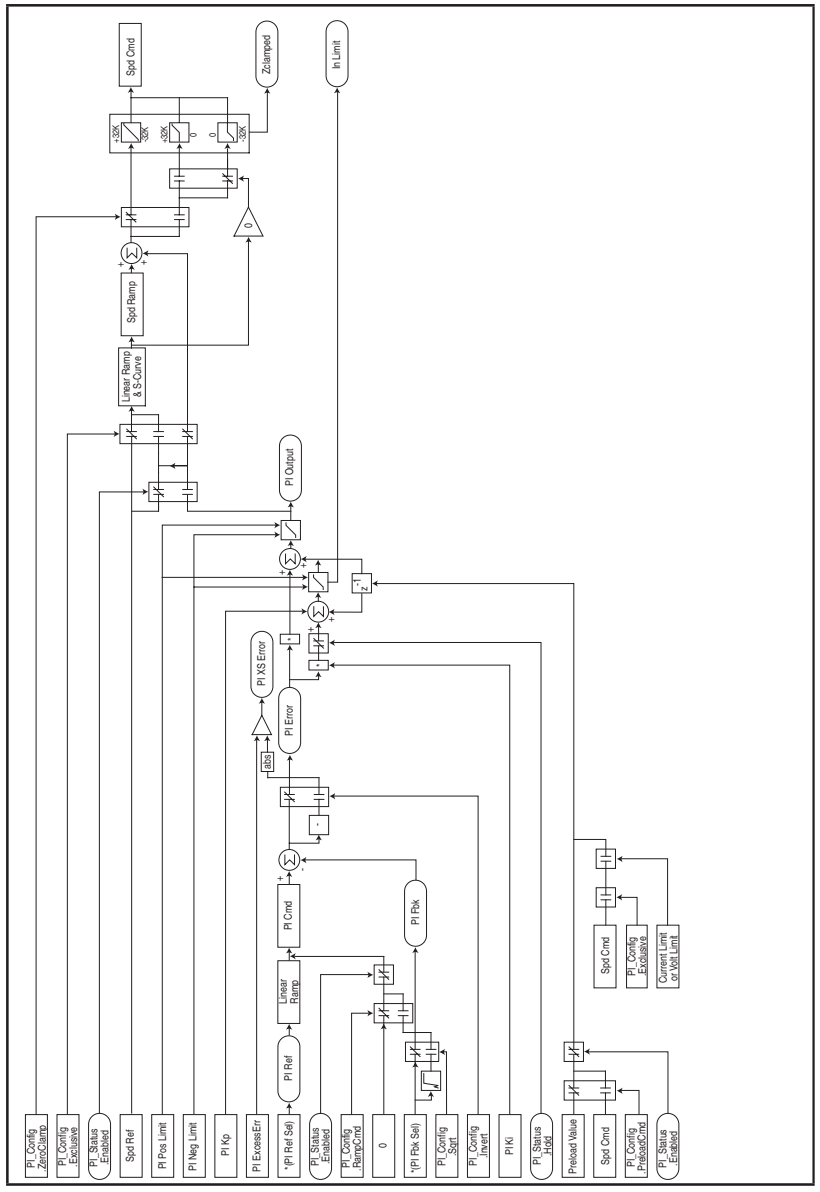
APPENDIX D

Analog Input Selection Path



APPENDIX E

Process PI Block Diagram



APPENDIX F

Record of User Settings: Advanced Access Level

No.	Parameter Name	Path (File>Group)	Setting
40	Motor Type	Motor Control>Motor Data	
41	Motor NP Volts	Motor Control>Motor Data	
42	Motor NP FLA	Motor Control>Motor Data	
43	Motor NP Hertz	Motor Control>Motor Data	
44	Motor NP RPM	Motor Control>Motor Data	
45	Motor NP Power	Motor Control>Motor Data	
46	Mtr NP Pwr Units	Motor Control>Motor Data	
47	Motor OL Hertz	Motor Control>Motor Data	
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84	Skip Frequency 1	Speed Command>Spd Mode & Limits	
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86	Skip Frequency 3	Speed Command>Spd Mode & Limits	
87	Skip Freq Band	Speed Command>Spd Mode & Limits	
89	Logic Source Sel	Speed Command>Control Src Select	
90	Speed Ref A Sel	Speed Command>Control Src Select Speed Command>Speed References	
91	Speed Ref A Hi	Speed Command>Speed References	
92	Speed Ref A Lo	Speed Command>Speed References	
96	TB Man Ref Sel	Speed Command>Speed References	
97	TB Man Ref Hi	Speed Command>Speed References	
98	TB Man Ref Lo	Speed Command>Speed References	
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102	Preset Speed 2	Speed Command>Discrete Speeds	
103	Preset Speed 3	Speed Command>Discrete Speeds	
104	Preset Speed 4	Speed Command>Discrete Speeds	
105	Preset Speed 5	Speed Command>Discrete Speeds	
106	Preset Speed 6	Speed Command>Discrete Speeds	
107	Preset Speed 7	Speed Command>Discrete Speeds	
117	Trim In Select	Speed Commands>Speed Trim	
118	Trim Out Select	Speed Command>Speed Trim	
119	Trim Hi	Speed Command>Speed Trim	
120	Trim Lo	Speed Command>Speed Trim	
121	Slip RPM @ FLA	Speed Command>Slip Comp	
122	Slip Comp Gain	Speed Command>Slip Comp	
123	Slip RPM Meter	Speed Command>Slip Comp	
124	PI Configuration	Speed Command>Process PI	
125	PI Control	Speed Command>Process PI	
126	PI Reference Sel	Speed Command>Process PI	
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128	PI Feedback Sel	Speed Command>Process PI	
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No.	Parameter Name	Path (File>Group)	Setting
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148	Current Lmt Val	Dynamic Control>Load Limits	
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156	Stop Mode B	Dynamic Control>Stop/Brake Modes	
157	DC Brake Lvl Sel	Dynamic Control>Stop/Brake Modes	
158	DC Brake Level	Dynamic Control>Stop/Brake Modes	
159	DC Brake Time	Dynamic Control>Stop/Brake Modes	
160	Bus Reg Gain	Dynamic Control>Stop/Brake Modes	
161	Bus Reg Mode A	Dynamic Control>Stop/Brake Modes	
162	Bus Reg Mode B	Dynamic Control>Stop/Brake Modes	
163	DB Resistor Type	Dynamic Control>Stop/Brake Modes	
164	Bus Reg Kp	Dynamic Control>Stop/Brake Modes	
165	Bus Reg Kd	Dynamic Control>Stop/Brake Modes	
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169	Flying Start En	Dynamic Control>Stop/Restart Modes	
170	Flying StartGain	Dynamic Control>Stop/Restart Modes	
174	Auto Rstrt Tries	Dynamic Control>Stop/Restart Modes	
175	Auto Rstrt Delay	Dynamic Control>Stop/Restart Modes	
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179	Sleep-Wake Ref	Dynamic Control>Restart Modes	
180	Wake Level	Dynamic Control>Restart Modes	
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184	Power Loss Mode	Dynamic Control>Stop/Power Loss	

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321	Anlg In Sqr Root	Inputs & Outputs>Analog Inputs	
322	Analog In 1 Hi	Inputs & Outputs>Analog Inputs	
323	Analog In 1 Lo	Inputs & Outputs>Analog Inputs	
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